

HAYDEN, AMANDA CODY, M.S. Optimizing Small Spaces: A New Typology for Living Functions of the Millennial Generation. (2010)
Directed by Thomas Lambeth. 131 pp.

The Millennial generation, people born roughly between 1982 and 2002, is the next generation of people to grow up and live in their own homes. When Millennials leave college and enter the working world, these young professionals often live in small spaces. With a limited amount of space for living functions of eating, working, relaxing and sleeping, a small space can be a challenge to furnish with traditional furniture. Millennials can also have a strong desire to express themselves and make an impact. There is more of a need for interactive furniture that the users can personalize to create their own space.

This thesis investigates cutting-edge contemporary furniture trends of multifunctional and interactive products, as well as thinner, sleeker products. This thesis also studies the characteristics of the Millennial generation and small spaces. Using this knowledge, this designer has developed a line of furniture components that can be assembled by the user to create various furniture pieces. From the product's material to its form and functionality, the products are designed to accommodate a small space and also meet the needs and desires of the Millennial generation.

OPTIMIZING SMALL SPACES: A NEW TYPOLOGY FOR LIVING FUNCTIONS
OF THE MILLENNIAL GENERATION

by

Amanda Cody Hayden

A Thesis Submitted to
The Faculty of The Graduate School at
The University of North Carolina at Greensboro
In Partial Fulfillment
of the Requirements for the Degree
Master of Science

Greensboro
2010

Approved by

Committee Chair

APPROVAL PAGE

This thesis has been approved by the following committee of the Faculty of The
Graduate School at the University of North Carolina at Greensboro.

Committee Chair _____

Committee Members _____

Date of Acceptance by Committee

Date of Final Oral Examination

TABLE OF CONTENTS

	Page
LIST OF FIGURES.....	vi
CHAPTER	
I. INTRODUCTION.....	1
II. REVIEW OF LITERATURE.....	2
Americans Downsizing.....	2
Studio Apartments.....	3
Designing for Small Spaces.....	4
Millennials.....	6
Millennials and Consumer Products.....	8
Precedents: Learning from the Japanese.....	11
Challenging Typology.....	13
Interactive Products.....	20
III. METHODOLOGY.....	25
Research Methods.....	25
The Design Process.....	26
Analysis.....	27
IV. ANALYSIS.....	29
Schematic Phase.....	29
Phase 2: 3D Modeling.....	42
Phase 3: Data Reduction.....	50
Phase 4: Testing.....	57
Phase 5: Working Out the Details.....	62
Phase 6: Constructing a Prototype.....	78
Phase 7: Further Development.....	84
V. CONCLUSION.....	92
REFERENCES.....	96
Environment and Social Behavior.....	96
Crowding.....	96
Furniture and Space.....	96

Housing Economy.....	97
Methodology.....	97
Millennials.....	97
Modern Architecture.....	99
Plastic.....	99
Precedents.....	99
Small Spaces.....	100
Downsizing.....	101
Japanese.....	102
APPENDIX A. A PREVIOUS STUDY.....	103
APPENDIX B. PAPER ON WOOD JOINERY AND RTA FURNITURE.....	122

LIST OF FIGURES

	Page
Figure 1: Toyo Kitchen, Isola S.....	12
Figure 2: Teenager's apartment, Paris, Designed by H2O Architects.....	13
Figure 3: Happy Bar, HI hôtel.....	17
Figure 4: Indoor Terrace.....	18
Figure 5: Digital.....	18
Figure 6: Up & Down	18
Figure 7: Techno Corner.....	18
Figure 8: Happy Day.....	19
Figure 9: White & White.....	19
Figure 10: Monospace.....	20
Figure 11: Rendez Vous.....	20
Figure 12: Strates.....	20
Figure 13: Digit Space, Matali Crasset.....	21
Figure 14: Poofs, Matali Crasset.....	22
Figure 15: Table Trays and Shelves, Matali Crasset.....	24
Figure 16: Sketch 1, Single Box and Cushion.....	30
Figure 17: Sketch 2, Double Box and Cushion.....	31
Figure 18: Sketch 3, Folding Couch Cushions.....	32
Figure 19: Sketch 4, Console Couch.....	33
Figure 20: Sketch 5, Art to Table.....	34

Figure 21: Sketch 6, Roll-Fold Table.....	35
Figure 22: Sketch 7, Puzzle Pieces.....	36
Figure 23: Sketch 8, Connecting Squares.....	37
Figure 24: Sketch 9, Wall Tiles.....	38
Figure 25: Sketch 10, Wall Tiles.....	39
Figure 26: Sketch 11, Seat-back Table.....	40
Figure 27: Sketch 12, Stackers.....	41
Figure 28: Render 1, Box w/Lid.....	42
Figure 29: Render 2, Puzzle Pieces.....	43
Figure 30: Render 3, Seat-back Table.....	44
Figure 31: Render 4, Stackers.....	45
Figure 32: Render 5, Wall Tiles.....	46
Figure 33: Sketch 13, Right Angles.....	47
Figure 34: Sketch 14, Right Angles.....	48
Figure 35: Render 6, Right Angles.....	49
Figure 36: Sketch 15, Wall Tile Seat Back.....	51
Figure 37: Sketch 16, Wall Tile Edge Styles and Seat Indent.....	52
Figure 38: Sketch 17, H-Clip Connection.....	53
Figure 39: Sketch 18, Dovetail Clip Connection.....	54
Figure 40: Sketch 19, Folding Dovetail Connection.....	54
Figure 41: Render 7, Right Angles with Dovetail Snap Connection.....	56
Figure 42: Photo 1, MDF Dovetail with Pegs and MDF Dovetail with Holes.....	58

Figure 43: Photo 2, MDF Right Angles with Warmy Maple Dovetail Connection.....	59
Figure 44: Photo 3, MDF Right Angles with Metal Connection.....	60
Figure 45: Photo 4, MDF Right Angles with Metal Connection.....	61
Figure 46: Render 8, Small Right Angle.....	62
Figure 47: Render 9, Medium Right Angle.....	63
Figure 48: Render 10, Large Right Angle.....	64
Figure 49: Render 11, Connection Detail.....	65
Figure 50: Render 12, Connection of 2 Medium Right Angles.....	66
Figure 51: Render 13, Connection of a Large and Small Right Angle.....	67
Figure 52: Render 14, Perpendicular Connection.....	69
Figure 53: Render 15, Cube Shelves.....	70
Figure 54: Render 16, Bed Platform.....	71
Figure 55: Render 17, Table Configurations.....	73
Figure 56: Render 18, Seating Configurations.....	74
Figure 57: Render 19, Room Divider Configurations.....	76
Figure 58: Photo 5, Prototype.....	81
Figure 59: Photo 6, Prototype Details.....	83
Figure 60: Render 20, Reinforced Plastic Right Angle.....	86
Figure 61: Render 21, Rounded Corners on Right Angle Design.....	87
Figure 62: Texture Samples.....	88
Figure 63: Standard Colors Samples.....	89
Figure 64: Bright Colors Samples.....	89

Figure 65: Light Colors Samples.....	90
--------------------------------------	----

Figure 66: Current Colors Samples.....	90
--	----

Appendix A

Figure 67: Sketch 1, Vertical Bed.....	108
--	-----

Figure 68: Sketch 2, Vertical Bed Folding.....	109
--	-----

Figure 69: Sketch 3, Horizontal Bed Folding.....	110
--	-----

Figure 70: Render 1, Desk and Shelves.....	111
--	-----

Figure 71: Render 2, Horizontal Bed.....	112
--	-----

Figure 72: Render 3, Small Parts.....	113
---------------------------------------	-----

Figure 73: Render 4, Midterm Room Renders.....	115
--	-----

Figure 74: Drawing 1, Section Drawings.....	117
---	-----

Figure 75: Materials.....	118
---------------------------	-----

Figure 76: Render 5, Final Room Renders, Open and Closed Configurations.....	119
--	-----

Figure 77: Render 6, Room Configurations.....	120
---	-----

Figure 78: Render 7, Opened Unit in Dorm Room.....	120
--	-----

Appendix B

Figure 79: Butt Joint and Cross-lapped Joint.....	125
---	-----

Figure 80: Doweled Joint and Miter Joint.....	126
---	-----

Figure 81: Dado Joint and Dovetail Joint.....	127
---	-----

Figure 82: Mortise and Tenon Joint and Tongue and Groove Joint.....	128
---	-----

Figure 83: Biscuit Reinforced Joint.....	129
--	-----

CHAPTER I

INTRODUCTION

The focus of this research is designing furniture incorporated into small spaces, and the freestanding furniture within small spaces. The designs concentrate on developing a new typology for furniture within small apartments. This collection of products is intended to accommodate the living functions of working, living, and eating. Based on a high percentage of the population that chooses to live in apartments, the research narrows in on a specific group of people, the Millennial generation. The Millennial generation is the next generation of people to grow up and live in their own homes, and thus, the hypothetical user for the space is a young single professional of the Millennial generation living in an urban setting. With this user group in mind, this designer has proposed an interactive furniture design that accommodates the needs of a small apartment.

Inspired by several contemporary cutting-edge furniture designs, as well as the consumer desires of the Millennial generation, this designer has developed a line of furniture components that can be assembled by the user to create various furniture pieces. The design maximizes a small apartment with its slim light form and an ability to serve multiple uses.

CHAPTER II

REVIEW OF LITERATURE

Americans Downsizing

Gopal Ahluwalia, director of research for the National Association of Home Builders says that the growth in the average size of new single-family homes that went from 1,750 square feet in 1978 to 2,479 in 2007, is now starting to reverse. His analysis of Census data shows that homes started in the third quarter of 2008 averaged 2,438 square feet. This number is down from 2,629 square feet in the second quarter. Ahluwalia says that the latest drop was much steeper than previous drops and is likely to hold even after the economy recovers. (Koch)

According to an Associated Press analysis of new census data, one of the reasons for the slumping housing market is that since 1990, homeowners have faced a growing gap between their incomes and the price of their homes. Nationally, from 1990 to 2006, the median household income grew by about 60%, roughly matching inflation. At the same time, the median home value more than doubled, to \$185,200. "We had an artificial economy," said Brad Geisen, founder of Foreclosure.com. "There was all this wealth created in real estate, and it wasn't really created." (The Associated Press)

Now with a poor economy and a high rise in energy costs, many people cannot afford larger homes, and they are resorting to living in smaller spaces. Builders have also

responded to people's demands and the economy by building smaller, better-crafted homes. In a survey of builders done in January 2009, it was found that 89% are building or planning smaller homes than they had been. The chief economist of the American Institute of Architects (AIA), Kermit Baker, also sees the shift toward smaller houses. In a survey in April 2008, the AIA found twice as many architects reporting a size decline rather than an increase. He says people are less likely to see a home as a good investment, so putting a lot of money into a large home may be less likely to happen. (Koch)

Studio Apartments

While some people are avoiding real estate investments in today's market, many young professionals are buying, and they are looking for apartments in urban areas. This younger generation is also showing more flexibility than previous ones by sharing space with their peers or possibly renting out space. (Celock)

Studio apartments are a common apartment type for students and other young adults living in urban or high-priced areas. Studio apartments have a single main room that serves as a sleeping, living and eating room. Many apartments also include a compact kitchen, or kitchenette, in the same room. The bathroom is a separate room, but not all studios will contain a private bath. Because of the compact size, studio apartments typically rent or sell for less than other types of housing. Most studio apartments range in size from 300 to 600 square feet and are often located in urban areas, where rents are high and space is limited. The focus of this research and design work centers on the interior product needs of young single professionals living in small studio apartments. (About studio apartments)

Designing for Small Spaces

According to Andrew Lam from New American Media, “Today a condo is what most in the middle class can hope for in places like San Francisco or New York. I suspect that in another generation or two, middle-class homes in American cities will look like those of Tokyo today -- which is to say, the size of a train compartment.” This Japanese minimalism has already started to become the dominant style in the modern world. A “bigger is better” mentality that included giant TVs that sat on the floor and huge speakers that take up a good portion of a room used to prevail for young consumers, but today, the modern style is to make things smaller and thinner. Laptops eliminate the bulkiness of the desktop monitor and modem. TVs are now thin and hang on a wall, and as for a stereo, iPods can plug into tiny speakers that are easily hidden in any room. With everything growing smaller, there is no need to have as large of a space to put things in.

Architect Sarah Susanka has developed the concept of the “Not So Big House” based on the growing number of oversized homes. The “Not So Big House” is not just a smaller house, but it is a smaller house with details and meaning in each of its rooms. Susanka explains how a larger house does not always make you feel like you have more space, and she shows ways in how a “Not So Big House” can feel larger and more comfortable than an ordinary home. While Sarah Suzanka applies these techniques to houses, they can still be applied to any home environment. Several of Suzankas methods of organizing and designing small spaces can be applied to designing a studio apartment. The key ideas for the “Not So Big House” that will be used in this design research are

dividing larger spaces into smaller areas, creating alcoves, using areas for multiple functions, designing specific places for technologies, and maximizing storage.

The dividing of space into smaller areas will create comfort and make the apartment feel larger. “When a space is overscaled, in relation to our own size, more often than not it doesn’t feel comfortable” (Suzanka pp17). Adding alcoves can then shelter an activity and make a space feel cozy. The dividing of a room into smaller spaces, enables the room to be used for a variety of functions and also have human-scaled spaces that are right next to other activities in the house. Suzanka calls this “shelter around activity.”

“Shelter around activity” is an instinct that begins at childhood. Children love to make cozy hideaways within a larger room. Adults also find this comfort in more cozy spaces. A change in ceiling height can create this separate cozy feel. Uniform ceiling heights feel very homogeneous, but by raising or lowering the ceiling in specific areas can make the space can feel like there are spaces within the space.

According to Suzanka, when dividing space, it is not necessary to think about each division as a separate function. Making the spaces flexible as dual functions for activity will create less clutter, and not as many spaces will be needed. Suzanka had spent several weeks with a Japanese family whose house was extremely compact. This family adapted their living style by changing the function of the rooms over the course of the day. For example, the living room became the children’s room at night. In a studio apartment, dividing the one-room space into smaller areas can create distinct sub-spaces, but each area does not have to have a separate activity or function.

While general spaces should be shared, designing specific places for computers, TVs, and other technologies can also eliminate clutter. Cable connections and power outlets should be placed in places where TVs are located, and built-in spaces for computers and TVs can help eliminate awkward furniture placement and clutter. Using spare areas and hidden spaces for storage can eliminate clutter and maximize the living areas. From spaces under the stairs, to walled-off sloped ceilings, extra space is often wasted. Maximizing every space in the studio apartment will help to save space in the living areas.

Millennials

Another consideration for designing smaller living spaces is that “a demographic force that waits in the wings will soon come of age and start to shape the housing market.” This next generation to reach adulthood, the “Millennials,” will begin to shape consumer trends just as previous generations have. Studies have shown that these young people want to live in exciting urban settings, and they consider smaller living spaces acceptable. (Brun)

According to a study in the book “The Millennials: Americans Born 1977 to 1994,” few young adults live in single-family homes. The majority of young adults live in apartments. Fifty-seven percent of householders under the age of 25 and 42 percent of householders age 25-29 live in multi-unit buildings. Based on this study, it was concluded that as the number of young adults grows with the aging Millennial generation, there is likely to be a strong demand for apartments. (The New Strategist Editors)

With a new trend for smaller housing, and the desire for young people to live in apartments and urban areas, the focus of this research and design work is on small urban apartments for the young single professional of the Millennial generation. The Millennial generation, or Generation Y, is the generation of people born roughly between 1982 and 2002. With concentration on middle to upper class, growing up in a world of technology, the Millennials are characterized as being more technically savvy. Most own computers, and adjusting to new technology is much easier for them as opposed to previous generations. The computer is no longer looked at as a technology, but a necessity of everyday life. With easy access to the Internet and cell phones, Millennials are much more connected to people and the outside world. Because of this connection to the world around them, they tend to be less cynical and more concerned with social issues than the previous generation, Generation X. Peers and the media are also a heavy influence on the Millennials. (Howe, Olsen)

Another characteristic of the Millennials is that they are more racially and ethnically diverse. One out of three is not Caucasian, and nine out of ten children under 12 have friends outside their own ethnicity. The Millennials have also grown up in a time where divorce is more prevalent. Children are more accustomed to growing up in households with working mothers or single parents. Daycare is also more common. This has helped make it easier and more comfortable in adapting to new situations. It has also made the Millennials more independent. (Howe, Kersten)

While many households are made up of single and working parents, the parents of Millennials children tend to be overindulgent and are characterized as “helicopter

parents.” The term helicopter refers to the way in which parents “hover” over their children. Parents are a great influence in their children’s lives and push them to go further. Parents want the best for their children, and will help them in any way. This support from parents has made the Millennials more empowered and driven. It gives them the sense that they can do or be whatever they want. They also have a sense of security and are more optimistic about the future. However, the closeness and security from parents may have a negative impact on social progress and developing maturity. The child is now the center of the household, and with everything from Internet to cell phones provided for them, it may be more difficult for the Millennials to break away from parents and live on their own. (The future of helicopter parents)

However, the Millennial generation is the next generation to move out of their parent’s homes and into the working world. With the research of small spaces and the needs and desires of the Millennial generation, the designer has created products for a small apartment that will suit the needs and characteristics of this age group. The user will be able to interact with this space and the furniture incorporated within the space.

Millennials and Consumer Products

In the book “Mind Your X’s and Y’s,” Lisa Johnson describes the 10 cravings of a new generation of consumers, and explains reasons for why this generation craves these things. The Generation Y (Millennial) Generation does not want the same things in consumer products as previous generations. These 10 cravings are as follows:

1. Shine the Spotlight- personal recognition, power for personalization
2. Raise My Pulse- try something new, exciting/interactive experiences
3. Make Loose Connections- connections to reflect interest/lifestyle/time
4. Give Me Brand Candy- more attractive/functional/personalized design

5. Sift Through the Clutter- editing and limiting choices to only the best
6. Keep it Underground- no pushy campaigns, better word of mouth
7. Build it Together- invite the user to participate
8. Bring it to Life- create emotional connections with customer
9. Go Inward- value of spirituality, less traditional gathering/expression
10. Give Back- spirit to volunteer, desire to make a difference

While keeping all 10 cravings in mind, the designer has focused the attention of the design work on four specific cravings. These cravings are “Shine the Spotlight,” “Give Me Brand Candy,” and a combination of “Build it Together” and “Raise My Pulse”.

“Shine the Spotlight” is the craving for personal recognition and the power of personalization. It is human nature to crave attention, and with reality TV shows, blogs, and community networks such as Facebook, this generation really has the ability to express themselves publicly. They want to be known and express who they are.

Many companies are responding to this craving with the ability to personalize products. For example, M&M’s can be customized with text and color, or you can build your own book bag with Timbuk2. These are only a few ways for people to express themselves through products.

“Give Me Brand Candy” is the craving for better design. People “naturally respond to things that look beautiful, smell good, have wonderful textures, delight the ears, and work intuitively.” Companies have been looking at ways to reinvent everyday objects to make them more functional and aesthetically pleasing. This has brought new colors, forms, and shapes into the marketplace, and there are now an abundance of styles to choose from. There is something much more appealing about a well designed product than the ordinary, and good design can lend credibility.

Design is the primary way to simplify products, spaces, and experiences in order to make life easier. Design also creates a “wow” factor that can “pop a brand out of the mainstream and into the spotlight.” Design is a form of self-expression, and the Generation Y is less intimidated by design rules. They are freer to experiment and are having fun with more choices. Products now have to include the entire experience and not just an isolated product. Designers must connect with consumers on a deeper level and anticipate their needs and desires.

“Build it Together” and “Raise My Pulse” are both cravings about participation and interaction by the consumer. “Raise My Pulse” is the craving of more exciting, interactive, and compelling experiences. Generation Y wants to experience and try new things. They want to engage their senses and emotions and be able to share them with family and friends. In today’s world, our environment is filled with mental stimulus (images, words, noise), but there is not much physical firsthand experience. This sparks more of a need for physical interaction. With innovations like Fantasy Football and iMovie, technology has given us the ability to participate and create on our own. This generation has a desire to get up and not just observe the world around them.

“Build it Together” is the craving to participate in some way. With today’s technology, people can comment on a blog, write a review, or play games with other people online. They can be involved as little or as much as they want to, but they have the option to interact and not just view.

Precedents: Learning from the Japanese

The Japanese have a lot that we can learn from when it comes to small spaces. Very few Japanese live in spacious houses. Japanese cities are so crowded that even small spaces are hard to come by. The typical student's apartment in Tokyo is often smaller than many walk-in closets in suburban American homes. There is "just enough room for a bed and a hot plate" (Smith). After graduating, apartments for working people are comparable in size to small Bay Area studios or one-bedroom units at about 400 to 550 square feet. After allotting space for a bathtub, the bedroom and living room are still only about 9 by 12 feet.

In the kitchen, stovetops are much narrower than American standard 30-inch-wide ranges, and refrigerators are the small and under-the-counter. Countertops and cabinetry are minimal as well. (Smith)

The Toyo Kitchen design, the Isola S from the Nobody collection is a Japanese kitchen made for compact spaces. This kitchen is made up of an island of two parts. There are three electric cooking rings, a circular sink and plenty of space for kitchen items. Isola S also has corrugated-bottom drawers for storing kitchen gadgets. The units can be positioned in different ways to accommodate different functions.

Traditionally, American kitchens are made up of fixed cabinets, countertops, and appliances. This Toyo Kitchen design challenges the norm with the ability to be moved around. It is a freestanding product that truly maximizes the space of a small apartment.



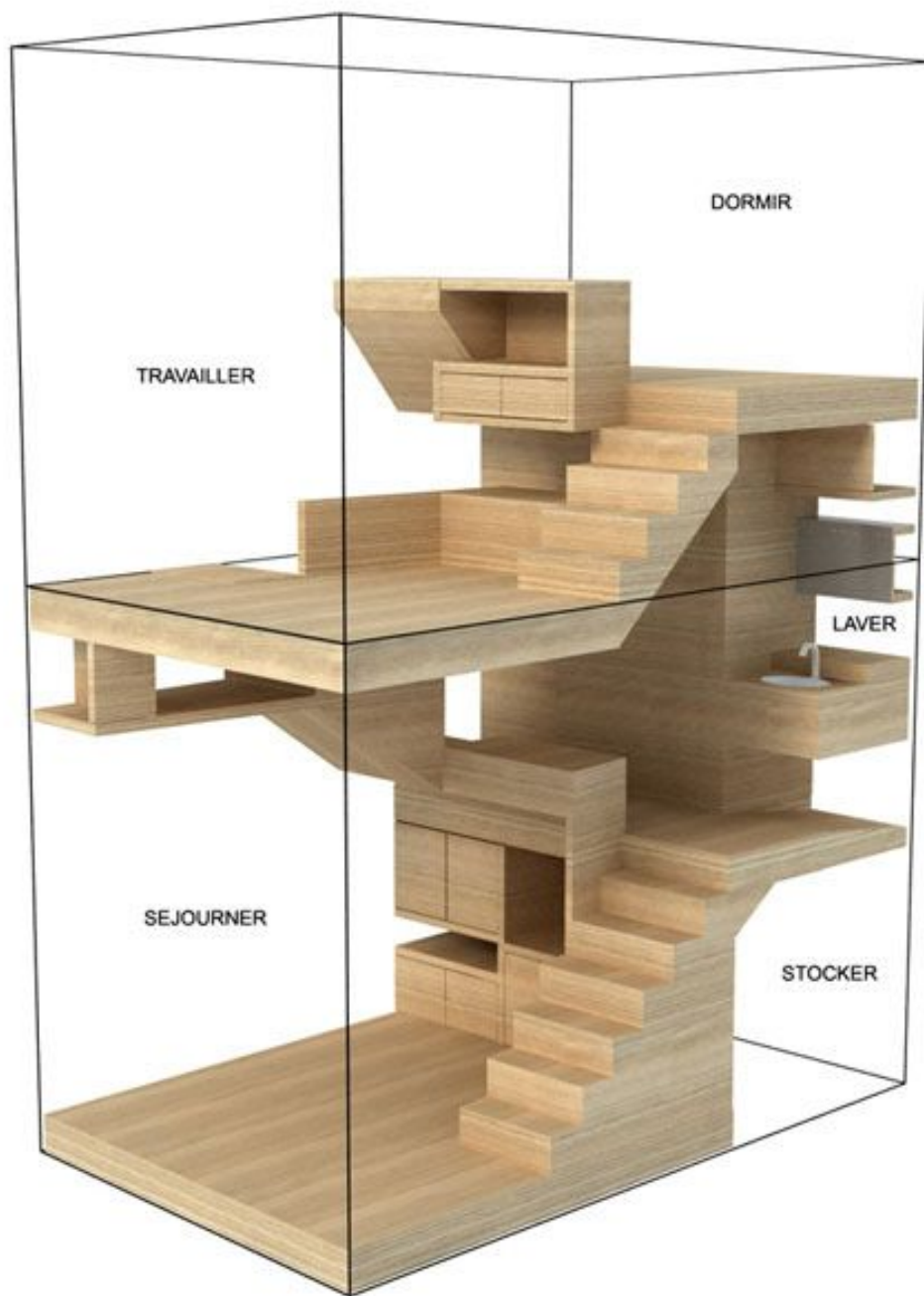
Figure 1: Toyo Kitchen, Isola S (<http://www.trendir.com/archives/002616.html>)

Challenging Typology

Architects Charlotte Hubert, Jean-Jacques Hubert, and Antoine Saniard of H2O were inspired by Japanese architecture when designing a small space interior in Paris. The architects were given a 12m² space to transform into a living space for a teenager looking for independence. Their solution was a system of furniture that forms the entire living space with more than 129 ft². The furniture includes all of the functions of daily life including sleeping, living, studying and washing. Interconnected spaces, closets, and cabinets are connected by a central stairway joining three levels. (Manaugh)

While this design was for a teenager, this teenager is of the Millennial generation. The design shows how the typology of a small space can be altered and also includes living functions of sleeping, living, studying and washing.





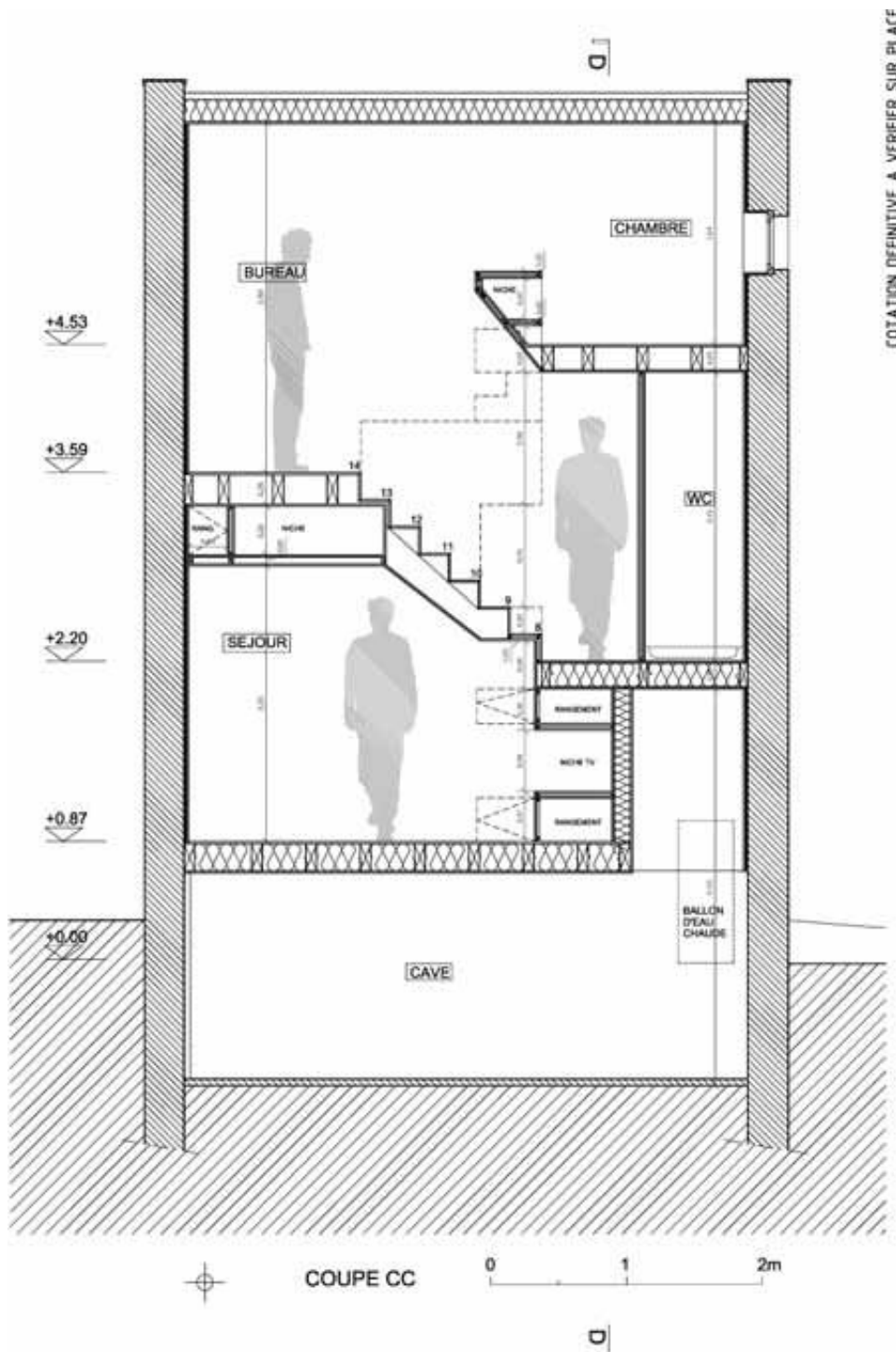


Figure 2: Teenager's apartment, Paris, Designed by H2O Architects
<http://www.unplggd.com/unplggd/home-office/unplggd-asia-living-inside-furniture-057249>

French designer, Matali Crasset designs everything from furniture to wallpaper and from architecture to household objects. Matali Crasset is known for challenging the typology of objects and for how space is perceived by the user. In a discussion between Matali Crasset and *Museums New York* magazine, Crasset discusses her design

Philosophy:

MNY: You once said that people are prisoners of décor. What did you mean?

MC: If we look at domestic design, there is a kind of cycle: Every two years, you have a new color, or objects change their shape a little. But things that comprise the domestic sphere change only in a very superficial way. We never change the typology of how people connect together.

MNY: So how would you describe your design philosophy?

MC: To welcome people in a contemporary time: to make them think about how we could live for now and not with the codes of yesterday.

Matali Crasset does this in her design for the HI hôtel. Crasset has designed everything in the hotel as well as furniture integrated into the entire space. The HI hôtel, located in Nice, France, is the first completely designed environment. The spaces in the hotel are designed to “invite us to discover, to try out and to live the contemporary” (www.matalicrasset.com). The rooms are designed with nine different concepts in mind, and the way that the space is organized transforms the rooms into places for activity, socializing, and modularity.

The Happy Bar is the focal point of the hotel. It is built around a suspended hot air balloon-style basket that creates a modern alcove. The basket filters light from both the street and the atrium garden. At night, lighting effects make for a festive atmosphere. Matali Crasset has designed the entire space from the architecture to the furnishings,

challenging the typology of a typical café area. The Happy Bar is a space that combines both the day time café and the late night lounge, thus saving space with multifunction.



Figure 3: Happy Bar, HI hôtel (<http://www.hi-hotel.net/uk/index.php>)

The HI hôtel also has nine concepts for the guest rooms. These guest rooms are designed to incorporate sleeping, living and washing functions within a small amount of space. Matali Crasset also challenges the typical typology of a hotel room with these rooms of the HI hôtel.

The Indoor Terrace room is arranged with all of the furniture in the central area. The furnishings form a stage where all living functions (sleeping, sitting, etc) take place. Digital is a room where the walls feature giant pixels and the furniture is a computer screen. One has a light box that shows still and moving pictures.



Figure 4: Indoor Terrace
(<http://www.hi-hotel.net/uk/index.php>)



Figure 5: Digital

Up & Down has a braided chestnut shelf laid high on the wall that runs across the room dividing it into two zones: the upper zone is for services, the lower zone, for relaxing. Techno Corner is devoted to image and sound like a private auditorium. A widescreen TV can be viewed from the bed or the bath. The room also contains “sofablaster,” which is a couch with integrated speakers and headphones, and a music collection in its armrests. This room particularly appeals to the Millennial generation with its incorporation of technology.

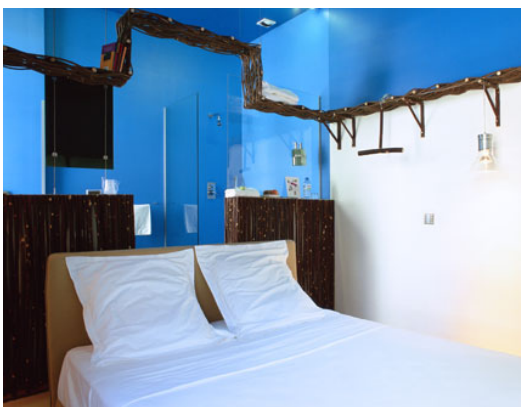


Figure 6: Up & Down
(<http://www.hi-hotel.net/uk/index.php>)



Figure 7: Techno Corner

Happy Day puts emphasis on changing from day to night through metamorphosis. During the day, the room is a lounge with a couch, and night, wooden panels behind the couch open to reveal the other half the bed. White & White is in immaculate white where the traditional codes of furniture have been disrupted. The table becomes a bed. The canopy bed becomes a bathtub.

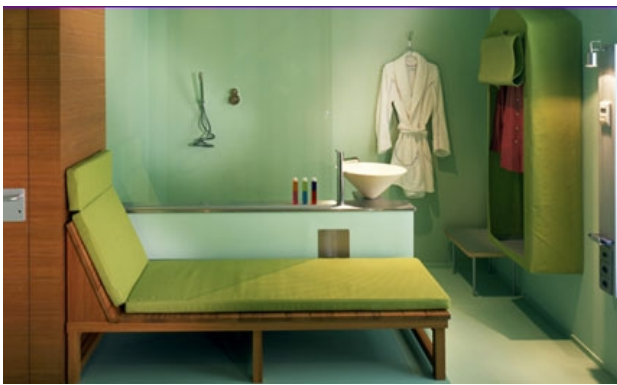


Figure 8: Happy Day
(<http://www.hi-hotel.net/uk/index.php>)



Figure 9: White & White

Monospace is an open space, with three sections. Each section is associated with a color or a function: comfort, relaxation and breathing. Rendez Vous is a modular area that can be a bath lounge or a working space. Upon entering, you discover a vast bathing area with a lava stone bathtub. This room has a private terrace, a complete living space with a shower, and adjustable seating.



Figure 10: Monospace
(<http://www.hi-hotel.net/uk/index.php>)



Figure 11: Rendez Vous

And lastly, Strates is a room in layers. From bottom to top, living functions are expressed vertically: storage, rest, hydrate, energize, decompress, and dream.



Figure 12: Strates
(<http://www.hi-hotel.net/uk/index.php>)

Interactive Products

Digitspace, designed by Matali Crasset, is a modular system for seating and supports. Its pieces can be combined in a multitude of ways to create seating for different

areas and a variety of activities. It is up to the user on how it is placed, thus allowing them to personalize and interact with their space.



Figure 13: Digit Space, Matali Crasset (www.matalicrasset.com)

Like Digitspace, Collection Digestion is a collection of despecialized objects that can be placed together in various ways to serve different functions. Digestion originated as foam-stuffed shopping bags from markets around the world, and is now manufactured by Edra. Another variation of this product is the more resilient HI Poof, designed for the HI hotel lobby. They take the same form as the Collection Digestion, but are made of high-resilience foam and coat fabric. The Poof is also designed to be stored vertically in a shelf. Each shelving system fits 3 Poofs.





Figure 14: Poofs, Matali Crasset (www.matalicrasset.com)

Table Trays & Shelves, also designed by Matali Crasset, is designed to suit the user throughout the day and to move naturally from one activity to the next by changing the tray. The metal table frame can fit several wood or metal trays that can be moved along the table or taken off entirely. When the trays are not in use, they can be placed as a shelf on the wall. This makes it easier to use the table for multiple activities and not have to clean up a project when it is not in use.

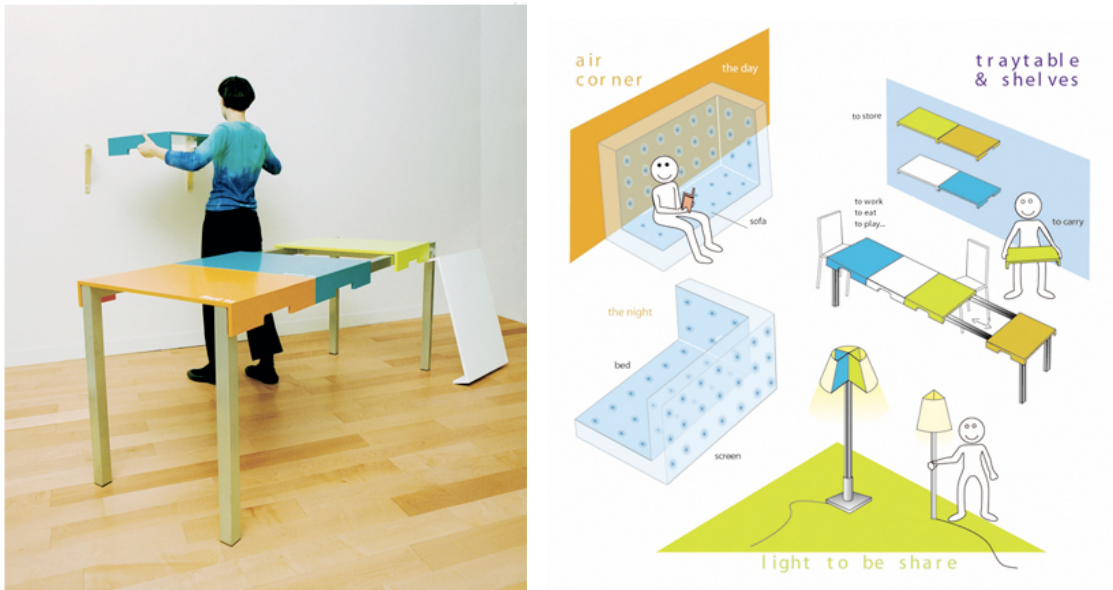


Figure 15: Table Trays and Shelves, Matali Crasset (www.matalicrasset.com)

All of these precedents satisfy cravings of good design, personalization, and interaction. The user can interact with and change the use of the products. They can personalize their space and the function of the furniture. Most of all, these products are new and creative designs that reinvent everyday objects. They really do create a “wow” factor.

CHAPTER III

METHODOLOGY

Using precedents from designers, research on small spaces, and the user group of the young single professional of the Millennial generation, the designer has created a series of interior products that best accommodates the needs of these young people living in small urban apartments. This design thesis is a documentation of the design process.

Research Methods

In *Visualizing Research* by Carole Gray and Julian Malins, Gray and Malins discuss several research methods for Art and Design. These methods are Practice, Observation, Visualization, Photography, Video, Sketchbook, 3D Models, Reflective Journal, Audio Reflection, ‘Sweatbox,’ Case Study, Interview, Questionnaire, and Personal Constructs. This thesis will document the use of a combination of Practice, Visualization, Sketchbook, 3D Models, and Reflective Journal in the development of the body of design work.

Gray and Malins define practice as “developing and making creative work as an explicit and intentional method for specific research purposes, for example gathering and/or generating data, evaluation, analysis, synthesis, presentation, communication of research findings.” This method is also documented through reflective journal, video, photography, or other methods listed above. Practice has been the primary methodological basis of this thesis.

Visualization is defined by Gray and Malins as “visual thinking; making visual ideas through a range of techniques in order to explore research project issues and/or present research findings.” Drawings, diagrams, concept maps, etc can stimulate visualization and help express ideas to others. Visual aids will be used often to communicate information with this thesis investigation.

The use of sketchbooks and 3D models will also play an important part in this thesis. A sketchbook is a “bound collection of sheets that contain the development of ideas over time, and subsequent reflection and analysis.” 3D models are a “three-dimensional experimentation of the research project issues with materials and processes that may result in a range of ‘approximations’ towards a more resolved construction/object.” These 3D models can be physical models made of paper, plastic, clay etc, or they can be produced digitally. Throughout the design process, the designer developed a series of sketchbook drawings and 3D models when exploring ideas and documenting the design process.

A reflective journal will also be used to document the design process. A reflective journal “goes beyond the use of the sketchbook in that it is a much more structured and deliberate research method.” This journal is made up of a variety of information and a range of media that solely relates to the research project. The designer consulted and added to this digitally on a regular basis.

The Design Process

The design process began with a conceptual stage consisting of extensive research. This research centered on small spaces and the Millennial generation, with a closer look at young single professionals living in small urban apartments. Research on small spaces

included the user group's reasons for living in small spaces. Research also included techniques for designing in small spaces, as well as precedents from other designers that challenge the traditional typology of furniture, products, and small spaces.

In the next stage of the design process, the schematic stage, the designer developed rough sketches in a sketchbook. As ideas were further developed, the designer experimented with 3D models to create and explore a range of ideas. These models were both physical and digital. The designer, professors, and peers reviewed the models and drawings to then narrow down to a select few. These ideas were elaborated further still in the development stage. After designs were more completely envisioned, they were narrowed down to one or two designs. The designer then digitally modeled those selected designs.

Throughout this design process, the designer documented ideas and thought processes with a digital reflective journal. The designer documented all drawings and models at various stages of development, and these images were added to the journal. These items provide the documentation of the design process for the basis of this design thesis.

Analysis

As stated in *Visualizing Research* by Carole Gray and Julian Malins, Gray and Malins, there are three key activities in analysis: data reduction, data display, and drawing conclusions. Data reduction is the sorting out and simplification of data. Data display is the presentation of data in a visual format that the viewers can overview and comprehend the information clearly. The final step is drawing conclusions.

With this thesis, the designer will collect the most important documentation and sort this into a logical order. The images, models, and information will be put into a digital presentation that will be presented by the designer. A formal critique will take place with faculty and peers to evaluate the results. This evaluation will take place at the conclusion of the Fall studio. The criteria for evaluation will include the following:

- Does the product challenge the typology of traditional furniture?
- Is the design effective for the needs and desires of the user group?
- Does the design work well in the intended environment?

Based on the critique, changes may be made to the design in order to improve it. The designer will continue to receive feedback from faculty and peers for a period of several months, and a final evaluation will take place at the conclusion of this thesis.

CHAPTER IV

ANALYSIS

This section will continue the discussion of the design process. The analysis section will describe in detail the previously discussed design process of the designer during the duration of this design thesis. This section will also include documentation of the design process with visuals of sketches, renderings, models, and prototypes. It will then conclude with possibilities for further exploration.

Schematic Phase

The first step of the design process began with brainstorming ideas with sketches that explored numerous ways for furniture to accommodate a small space and serve multiple functions. The initial idea of the designer included the use of soft and hard surfaces to create seating and work space. Soft surfaces, especially fabric-covered cushions, would be used for seating and comfort. The hard, plastic or wood surfaces could be used as work surfaces or a place to eat.

One idea uses solid boxes and cushions to make different furniture forms. The cushions can be stored within the boxes, set on top of the boxes, or set along side the boxes. Each configuration serves a different purpose. Also, the ability to store the cushions saves space when the cushion is not needed.

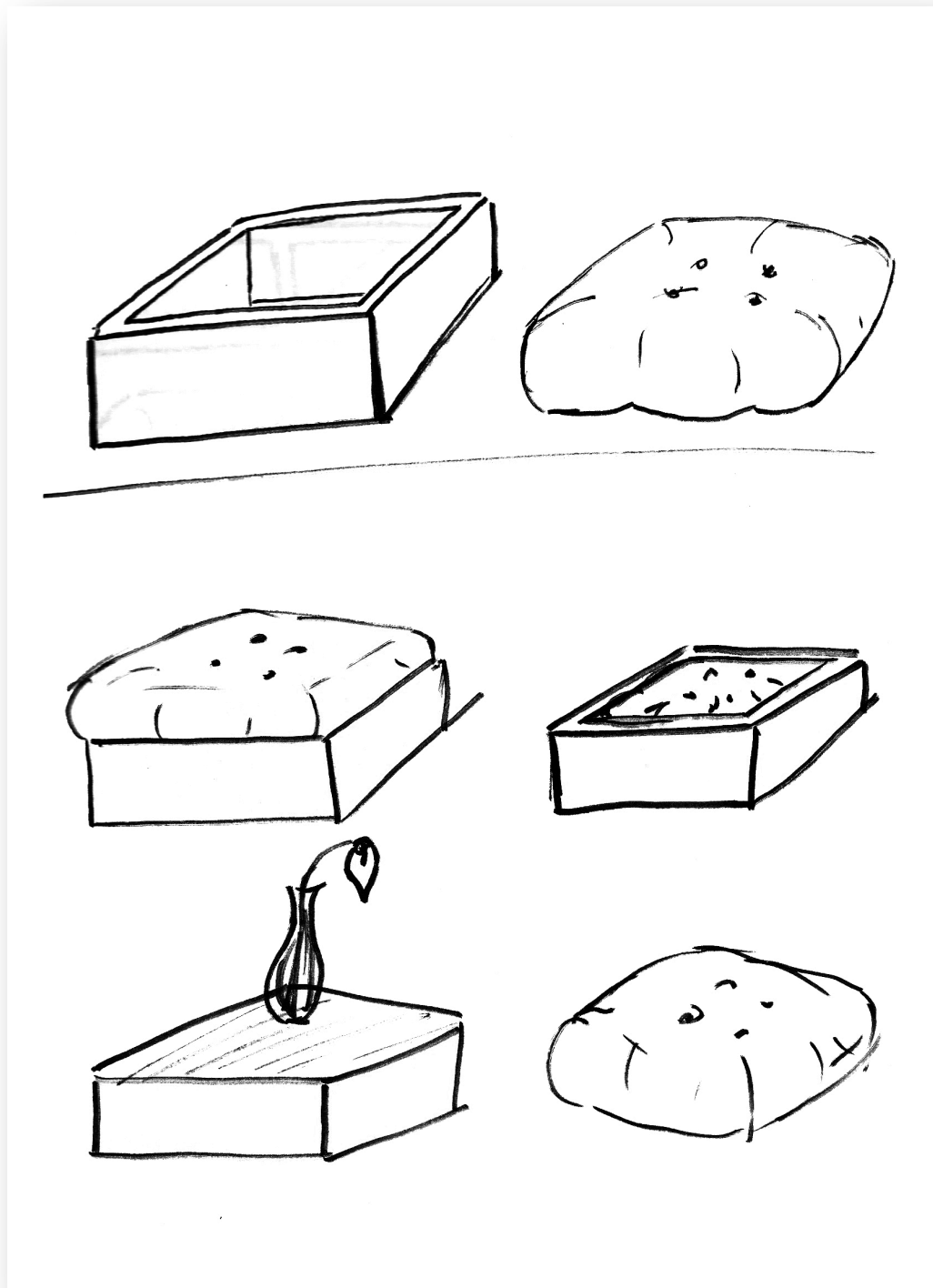


Figure 16: Sketch 1, Single Box and Cushion

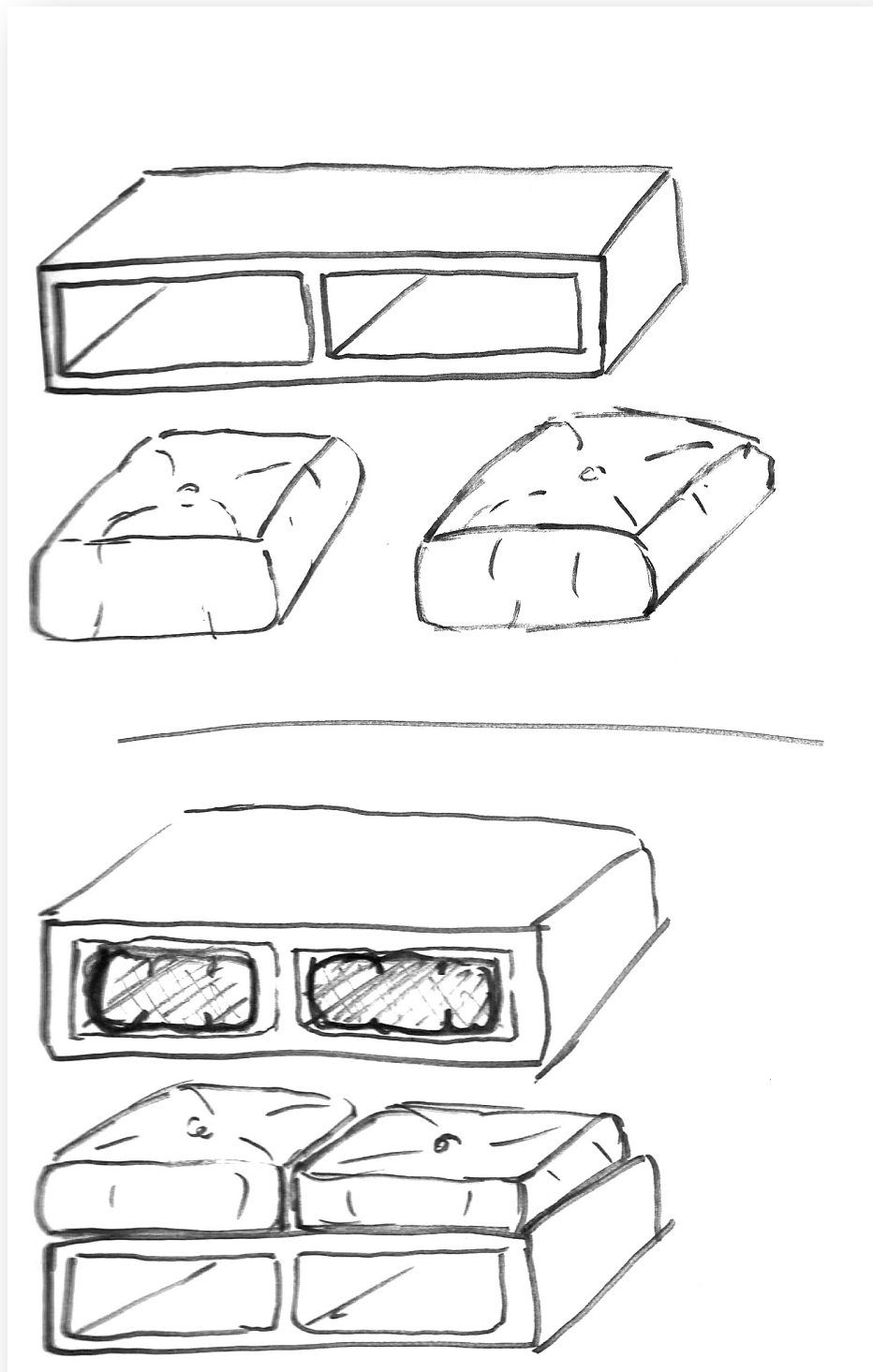


Figure 17: Sketch 2, Double Box and Cushion

Another idea was the use of a folding mechanism to alter the function of the piece. This technique may have resulted from previous work done by the designer. (See Appendix A) Like the folding dorm bed, furniture can be stored away when not in use. Combined with different surface materials, folding the cushions on a piece of furniture can also change its use from seat back to table.

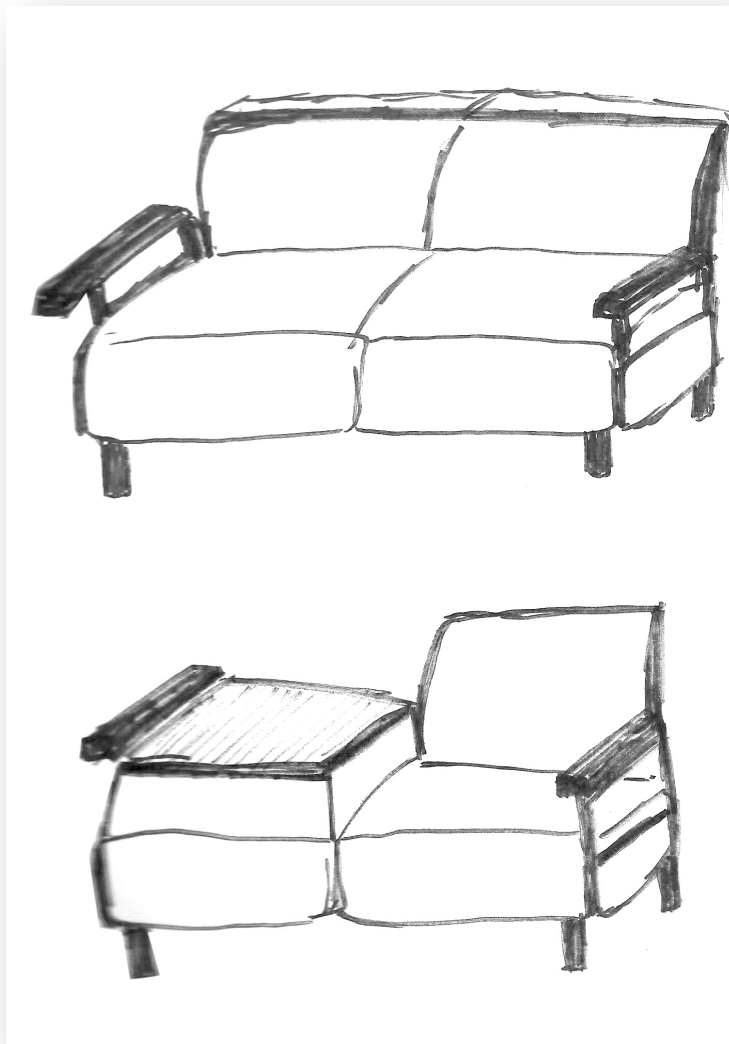


Figure 18: Sketch 3, Folding Couch Cushions

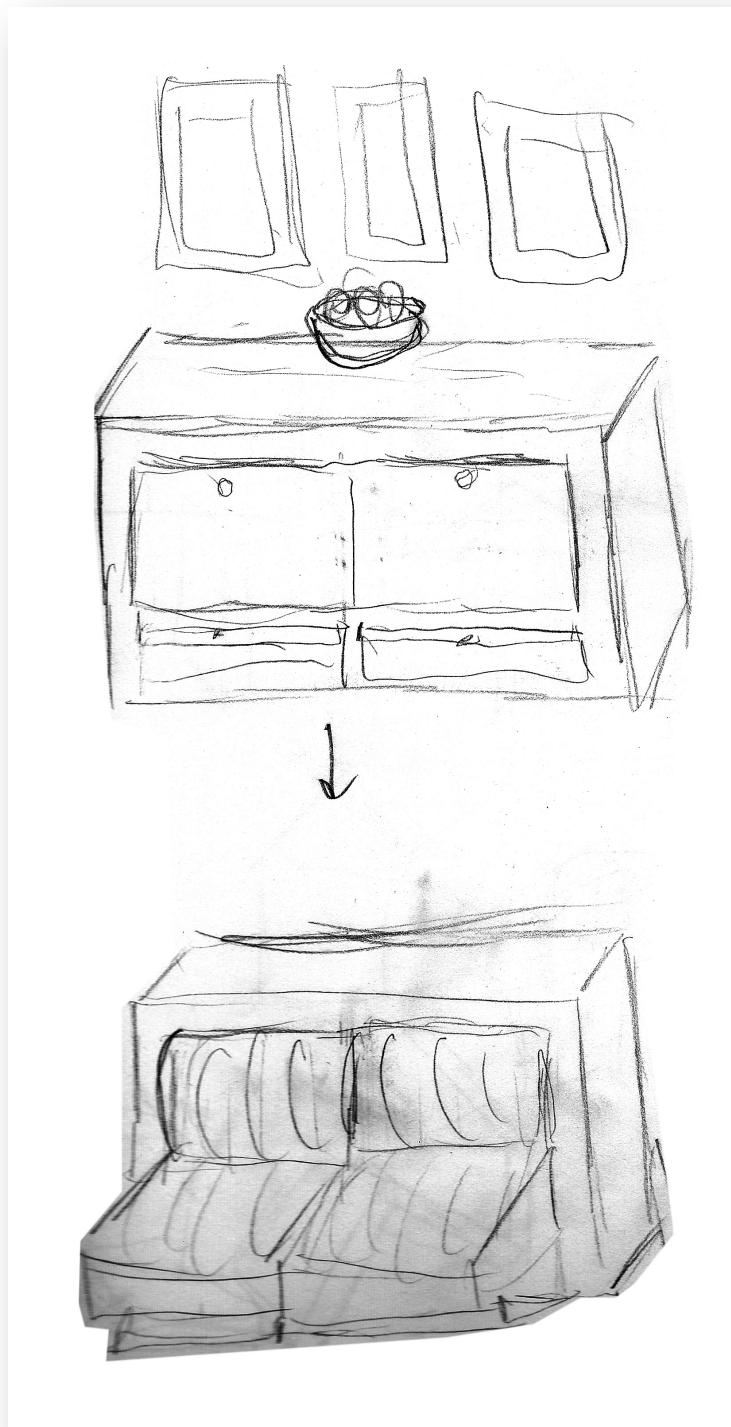


Figure 19: Sketch 4, Console Couch

Based on the folding technique, the idea to make artwork fold out from the wall to form a table was developed. Wall art is a way to personalize a space and show one's individuality. It also takes up very little space. If the art has a solid surface on the backside, and is fitted with a folding mechanism, it could fold out from the wall to form a table. The table can be used for eating, working, or as a simple side table.



Figure 20: Sketch 5, Art to Table

Looking at folding in a different sense, the designer formed another idea. The idea consists of a metal frame structure that folds in the middle to form a tall rectangular pillar. When opened up, it forms a coffee table. When in pillar form, a slim padding is rolled up inside. When opened, the padding is unrolled to form a cushion. This cushion can be placed on top of the table to convert it to a place for seating. This idea of a rolled up cushion was inspired by a product by Matali Crasset, “Quand Jim Monte a Paris” [*when Jim comes to Paris*], a roll out sleeping space for guests.

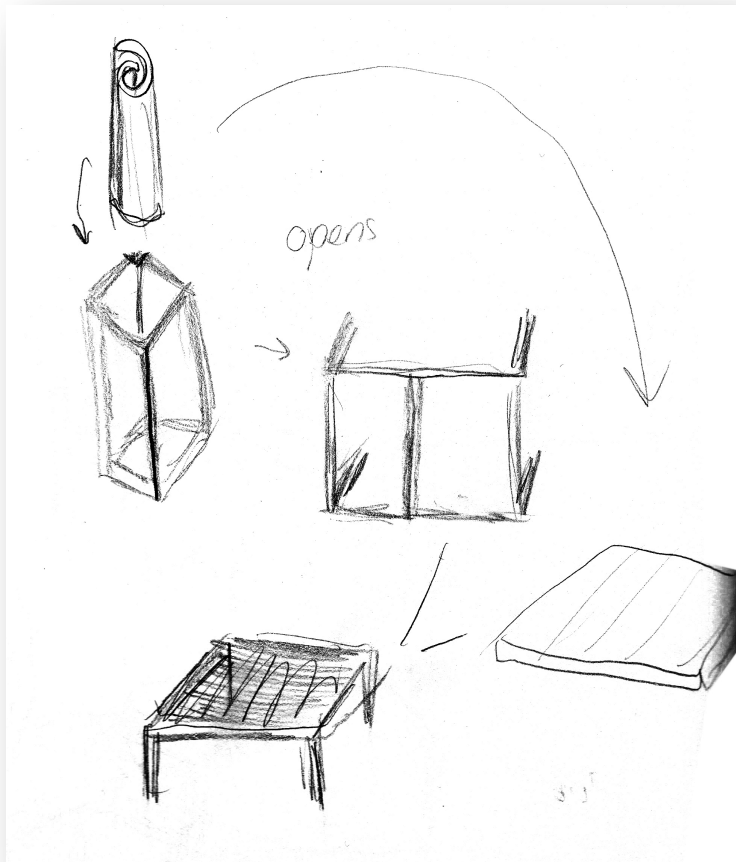


Figure 21: Sketch 6, Roll-Fold Table

Next in the design process, folding was set aside, and a new idea of creating simple shapes that could be put together in different ways to form seating and tables was developed. One of these ideas consists of two different shapes that piece together like a puzzle. Separately, they do not look like they serve any purpose, but when pieced together, they form seating with a back and arms. Multiples of these pieces can be placed together to increase the size of the furniture or alter the function.

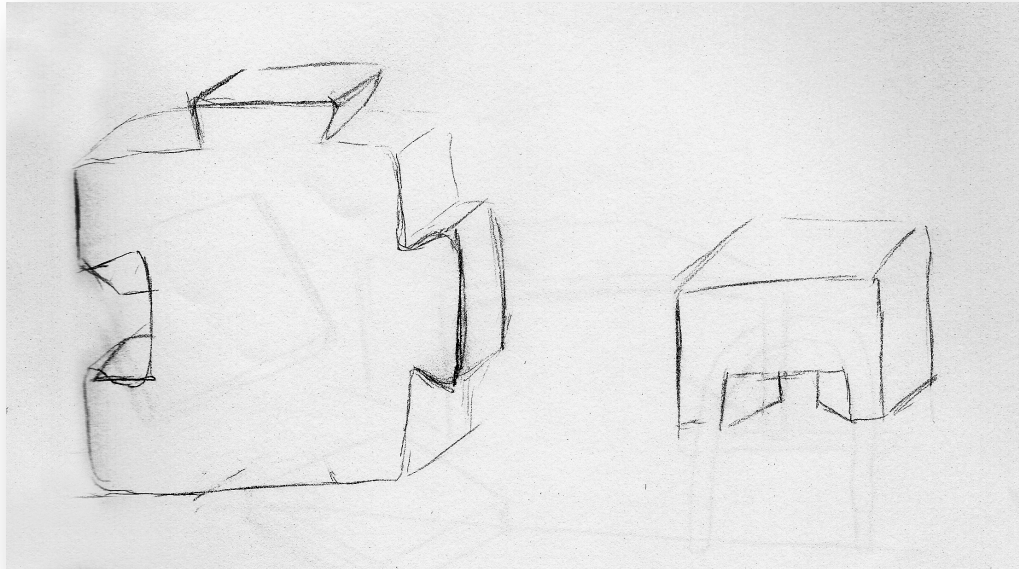


Figure 22: Sketch 7, Puzzle Pieces

Another design with this same concept in mind is the formation of square tiles that can slide onto one another to form different sized surfaces. Another component is a curved metal bar that can slide onto the sides of the squares. This bar serves as the legs for tables and seating. Longer bars can serve as structural support.

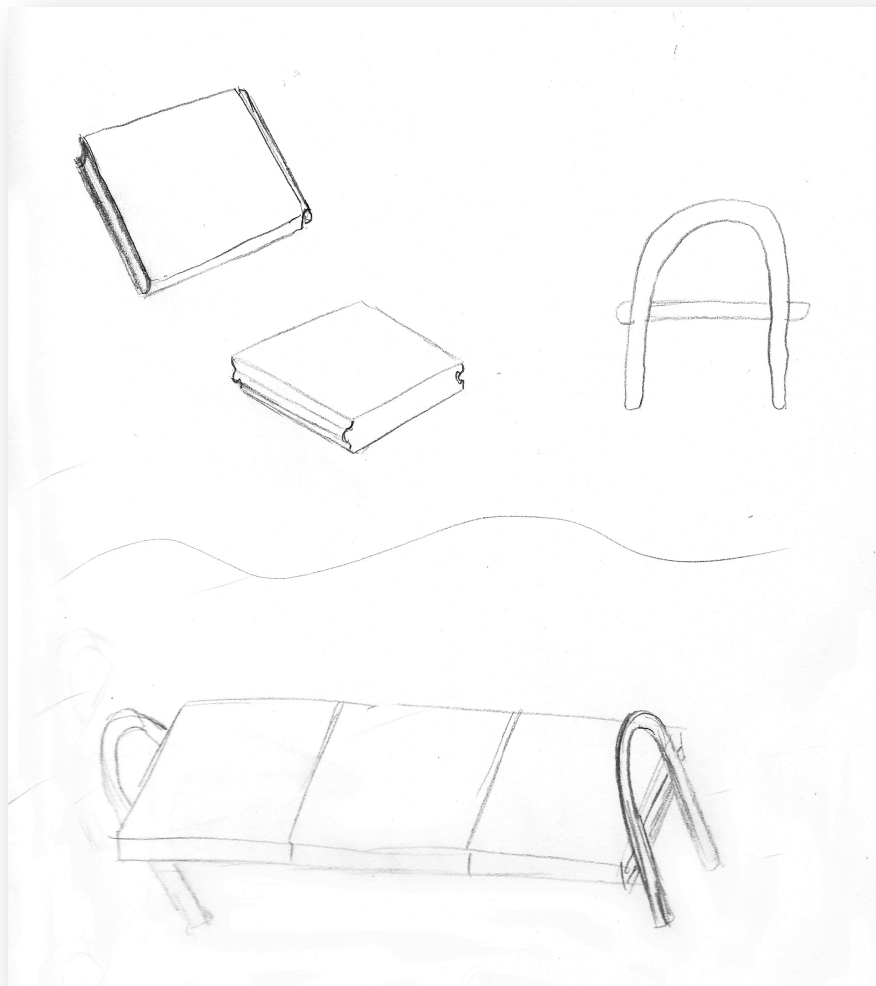


Figure 23: Sketch 8, Connecting Squares

This idea of connecting squares was then carried out into an idea combining this with the folding wall art idea. Wall art doesn't take up much space, so storing furniture on a wall can help conserve space when it is not in use. Wall tiles are a common form of wall décor, and can be placed in groupings such as a four by four square. Wall tiles can also be displayed in different colors, textures, and designs. This idea uses wall tiles as the components of furniture. Each tile is slid onto two rods and the rods are hung on the wall.

When furniture is needed, the tiles can be taken down from the wall, the rods can bend, and the tiles then become surfaces for seating and tables. The rods provide the structure. These tiles can come in different colors and have different patterns that blend together to form interesting and personalized displays on the wall, as well as fun interactive furniture.

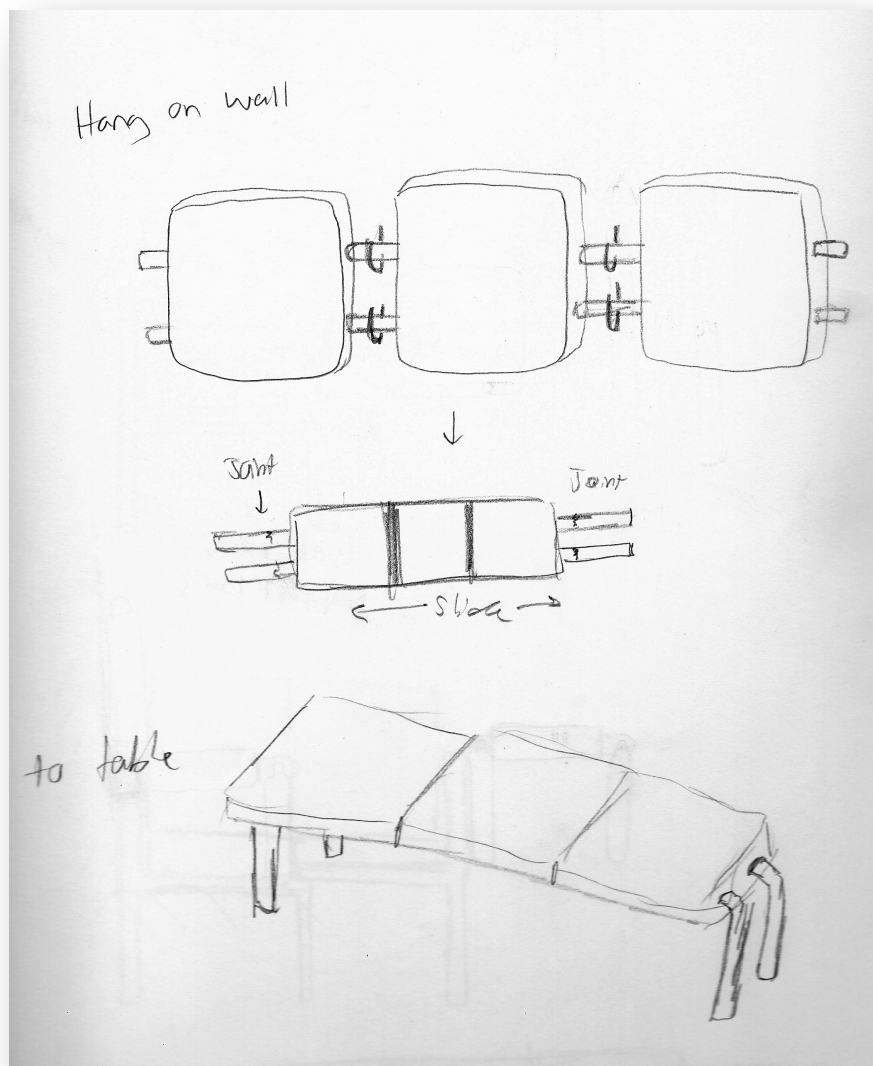


Figure 24: Sketch 9, Wall Tiles

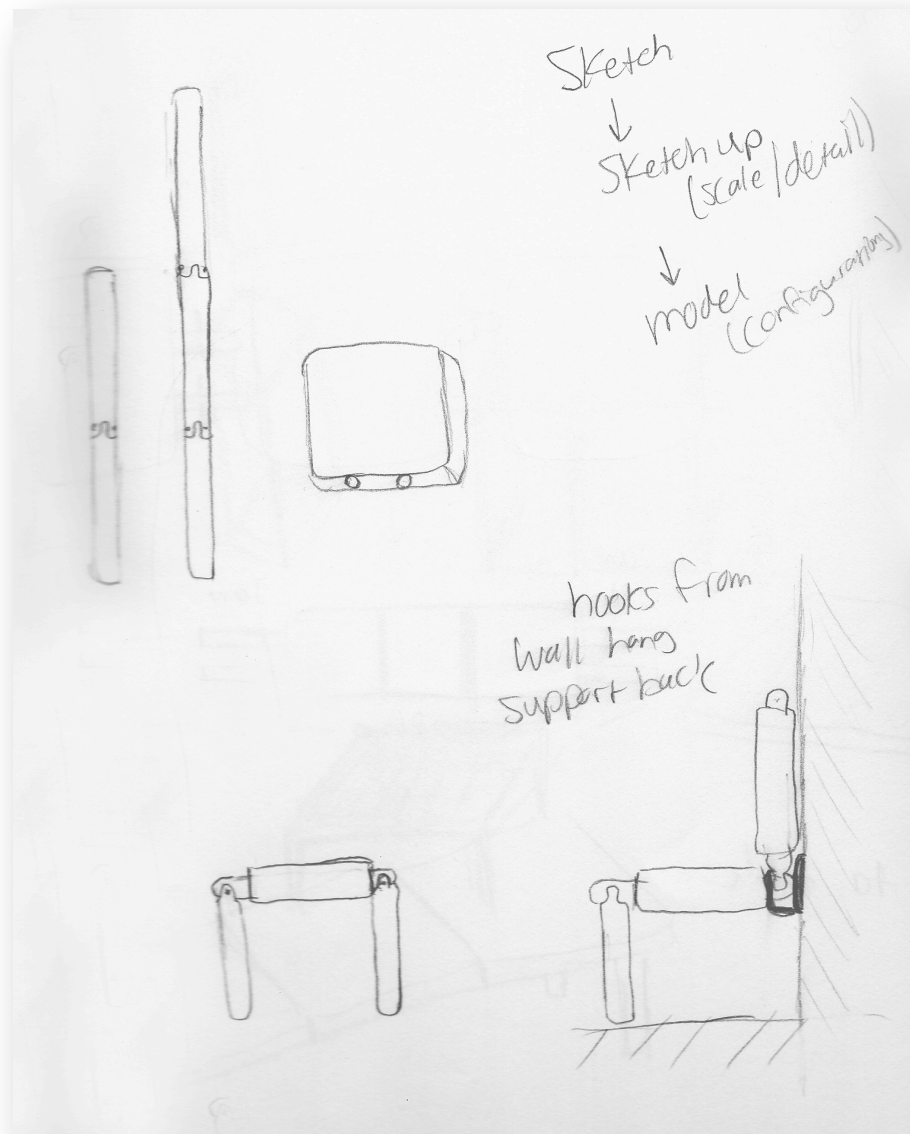


Figure 25: Sketch 10, Wall Tiles

Another idea using several components to form different furniture for different functions is the “Seat-Back Table.” One component is a stiff rectangular cushion with a groove around the edge. The other component is a curved piece that is hard on the outer

side and soft on the concave side. This piece can fit into the groove of the cushion and become a seat back, or it can be turned and placed on the floor as a table.

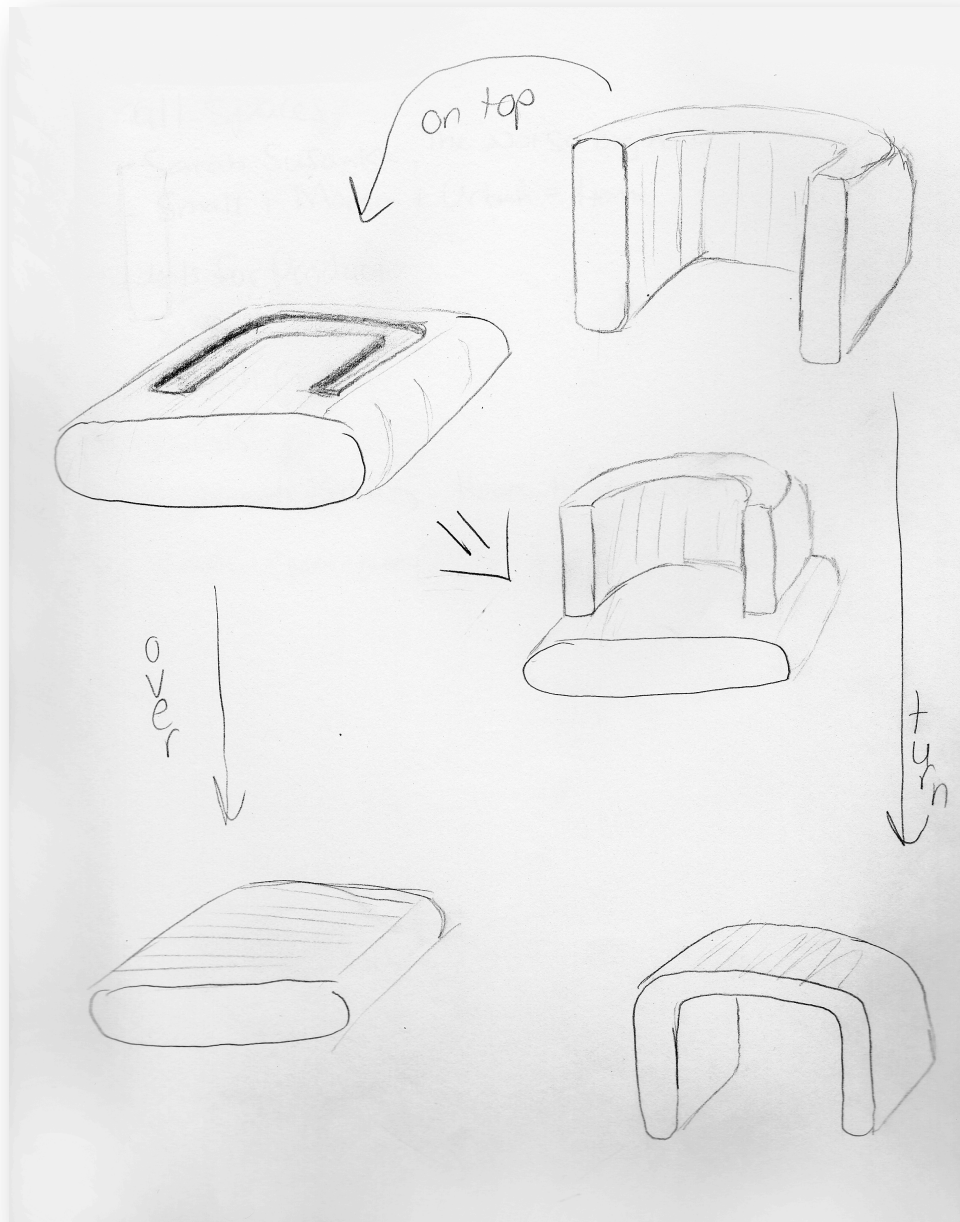


Figure 26: Sketch 11, Seat-back Table

Inspired by the table form of this seat back, the designer formed the “Stackers” idea. This design also uses several components to make different forms of furniture, but with this design, there is only one form that is multiplied and placed together in different ways to make the various furniture forms. The legs of this table shape are at an obtuse angle to the top. This allows for the pieces to stack on top one another to save space when they are not in use. Also, if a platform is placed across two pieces, a bench is formed. This could be another component.

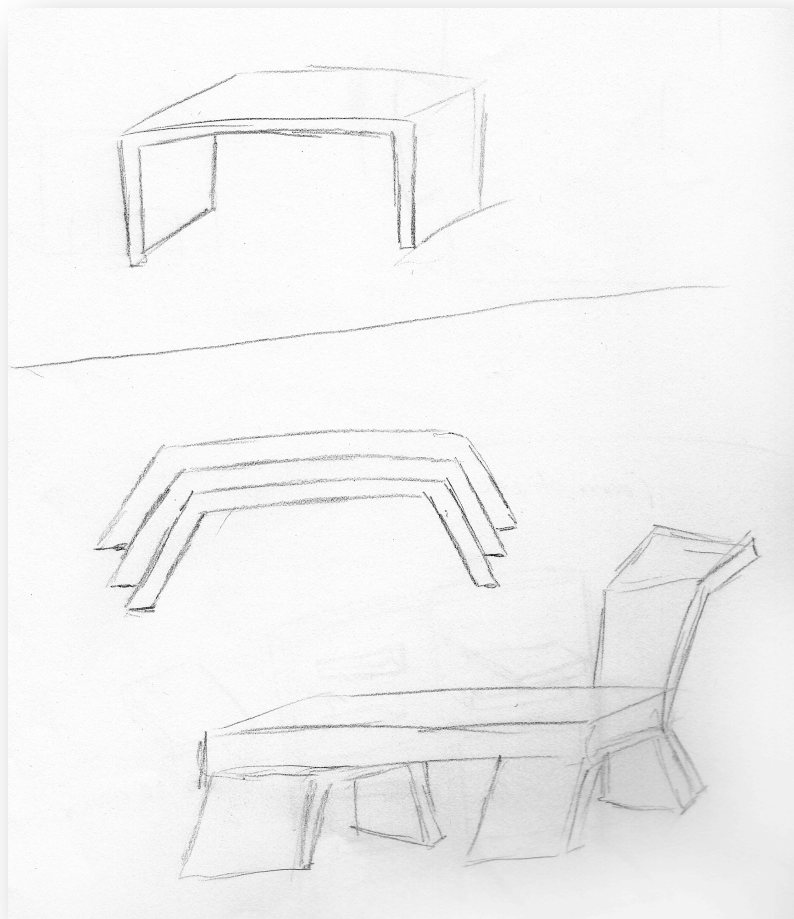


Figure 27: Sketch 12, Stackers

Phase 2: 3D Modeling

After exploring many possibilities through sketches, the designer decided to change mediums and test some of these ideas in a 3D modeling program. The designer used SketchUp to build several ideas to see how they would fit together and also to test their proportions.

The first rendering done is a box with a soft lid that is used as a seat. When flipped over, it is hard and can be used as a table. This rendering was made to test a new rendering program, Hypershot. This was also to explore materiality and the use of hard and soft surfaces.

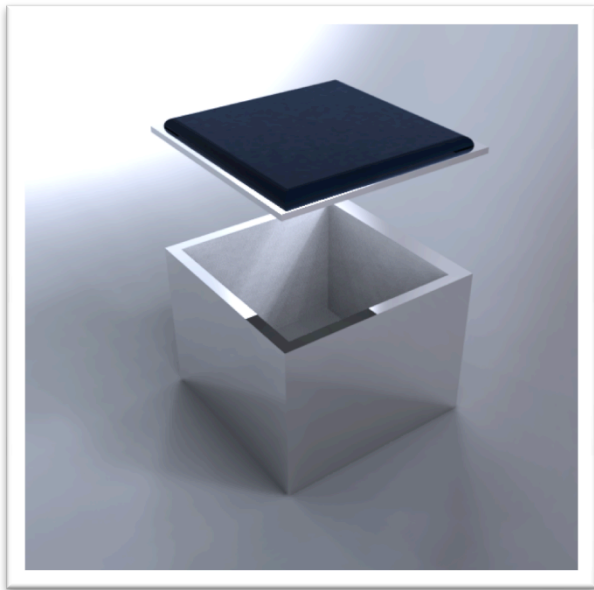


Figure 28: Render 1, Box w/Lid

After exploring a new program, the designer selected several concepts that could be further explored in 3D. The folding ideas were eliminated because they do not provide enough interaction and personalization. The ideas chosen to develop were the ones that

included multiple components that could be placed together in various ways. This is more appealing to Millennials because there is more creativity involved in configuring the furniture. The furniture can also be personalized, not only by color and texture, but also by how the components are configured. The ability to change and reconfigure furniture to make different functions also appeals to the Millennials desire to interact with products.

When built in 3D, the “Puzzle Piece” idea was not as effective as when sketched. In order to have a large enough place to sit and also have a cut out for connection, the pieces would have to be larger than desired. The puzzle tab would also extrude too far out from the main area, and the piece would be too big for a small space. There were also not many configuration possibilities with this idea.

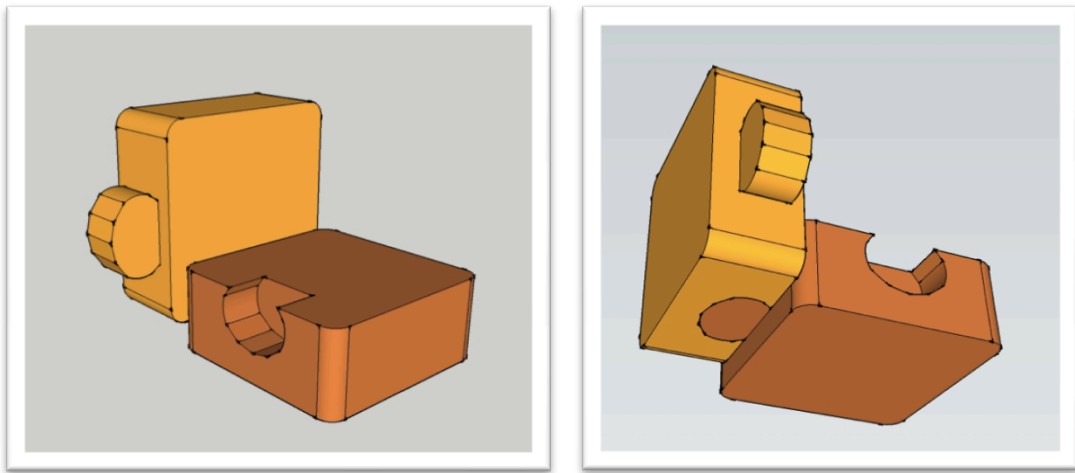


Figure 29: Render 2, Puzzle Pieces

The “Seat-Back Table”, when modeled in 3D did not work as well when modeled like the sketches. Some alterations were made. A slant was added to one side, so when placed in the seat, the back is tilted to provide more comfort. The back is also not as

curved, so when it is used as a table, the table can remain flat. It is also somewhat thinner, so then the slot in the cushion does not have to be as thick and take up too much space on the seat. While this design provides the user with seating and table, it does not have many configurations. So, like the previous, this idea was also discarded.

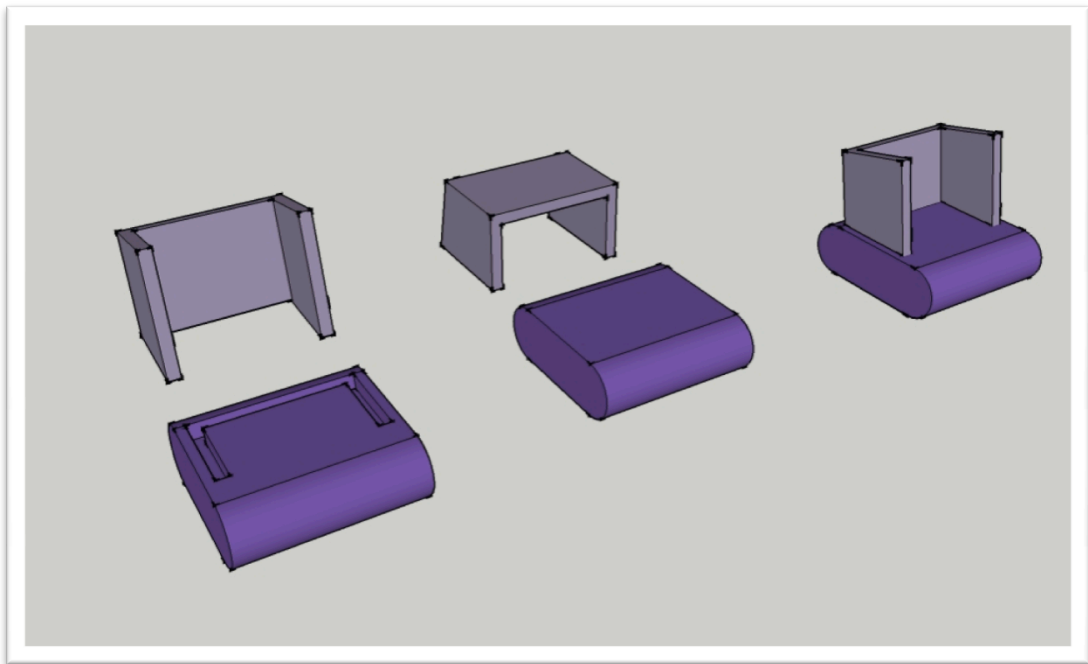


Figure 30: Render 3, Seat-back Table

The “Stackers” idea, while appearing simple, was actually much more complex when built in 3D. In order to stack the pieces, the angle between the tabletop and legs must be wide enough, or the pieces will not stack. With a wider angle, the space between the pieces will decrease. It took several tries before the pieces were able to stack with a minimal space between them, however, once the pieces were the correct shape, they gave positive results. These shapes were more versatile than the previous. When put together, these shapes could make a larger variety of configurations.

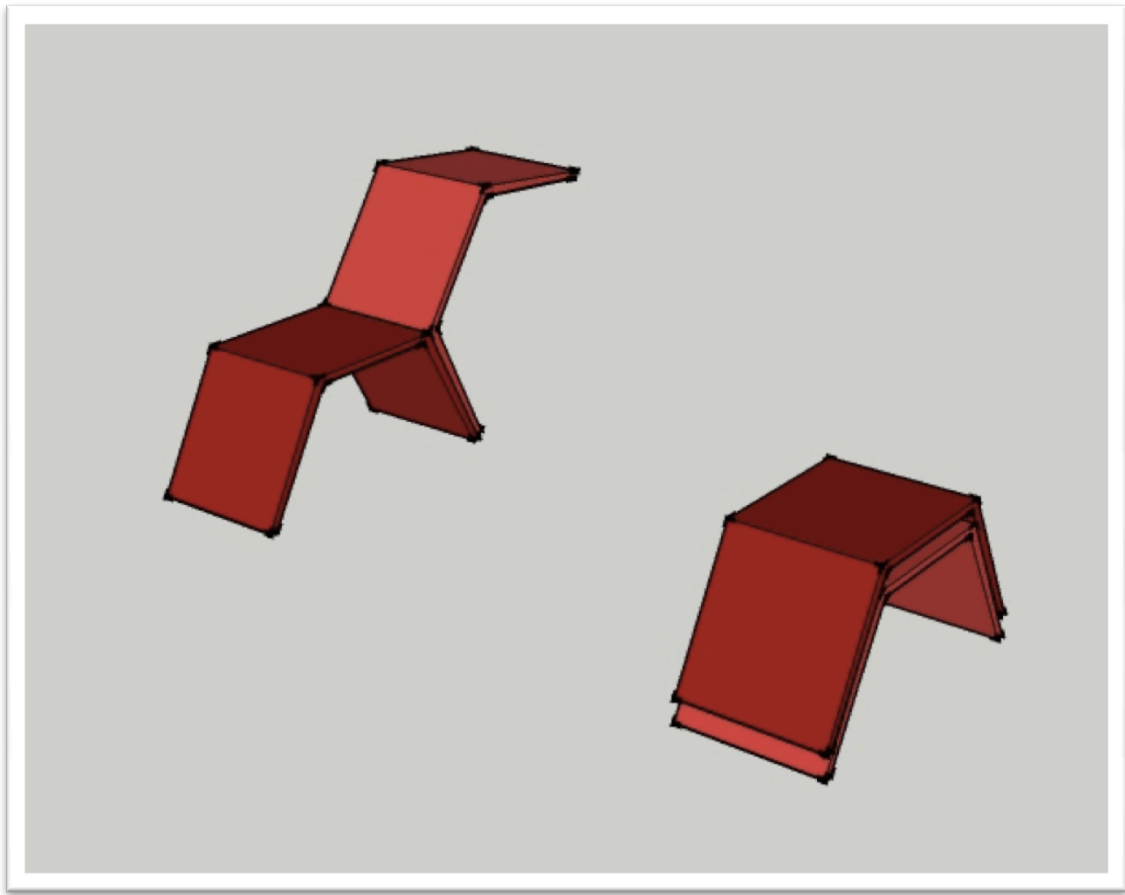


Figure 31: Render 4, Stackers

Similar to the “Stackers,” the “Wall Tiles” were also more versatile. They have even more combinations than the “Stackers.” They also serve as a wall décor when not in use. The wall hanging system, as well as tables and stools were easy to create. Chairs with a back were more difficult. Another type of connection had to be created to allow for a back. At this point in the design, a back can be added by clipping the rods in the back to the rods of the stool legs. After discussions with the professor, the chair configuration should be explored further, as well as the details of the rods and tiles.

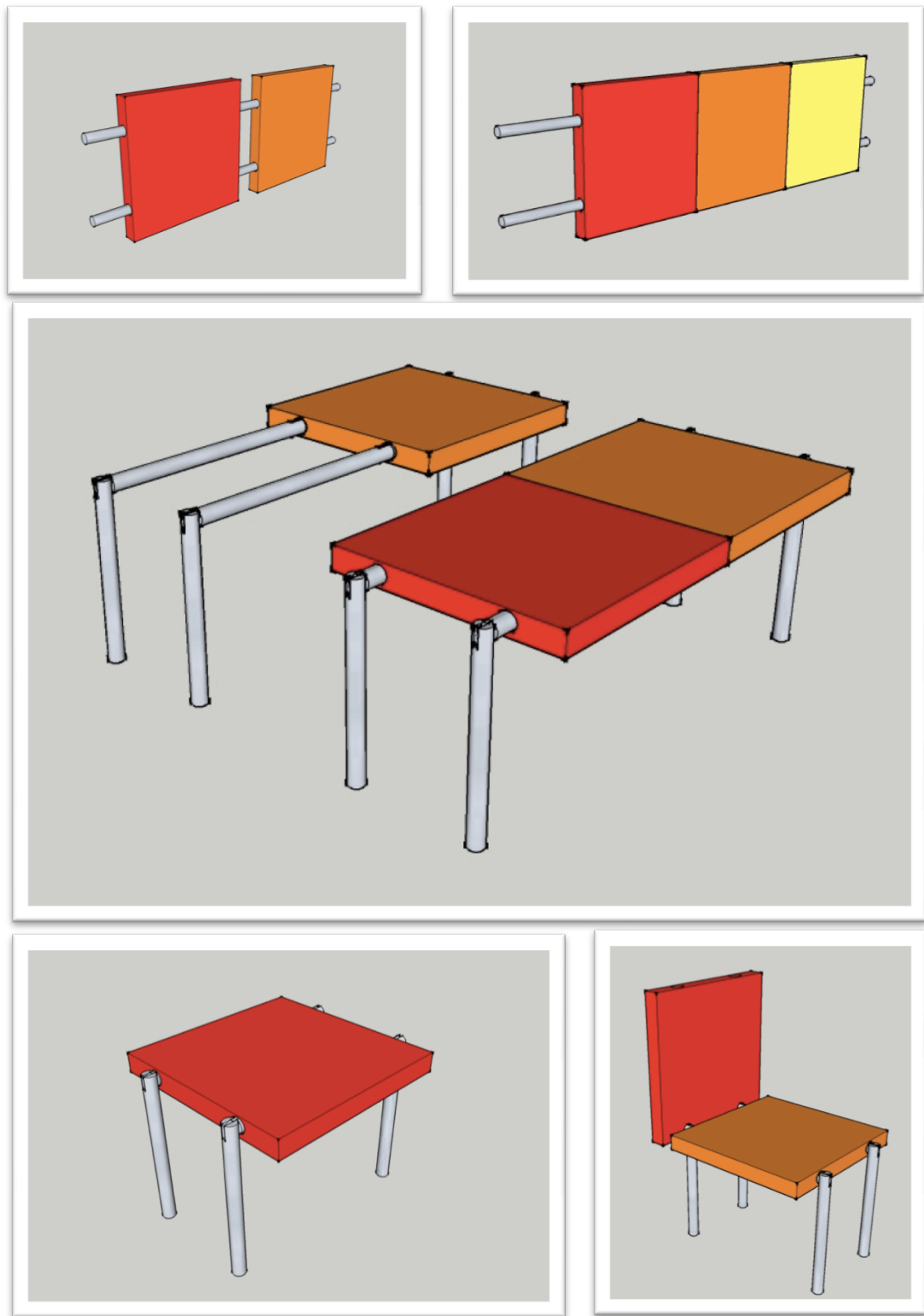


Figure 32: Render 5, Wall Tiles

Another idea that was explored further was the “Stackers”. This idea was developed further and transformed into the “Right Angles” design. Instead of each piece having three planes, it would only have two. There would also be a 90 degree angle at the joint instead of the obtuse angle. These pieces can still stack, but the configurations are more versatile and they take up less space. The development of this idea began with sketches and was then further explored in SketchUp.

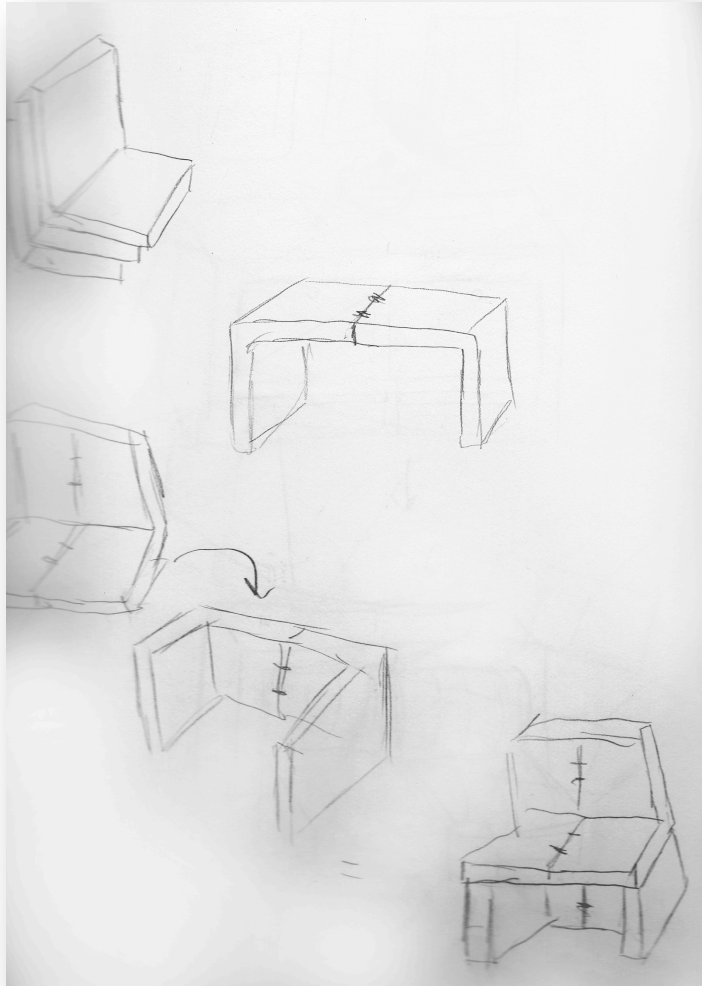


Figure 33: Sketch 13, Right Angles

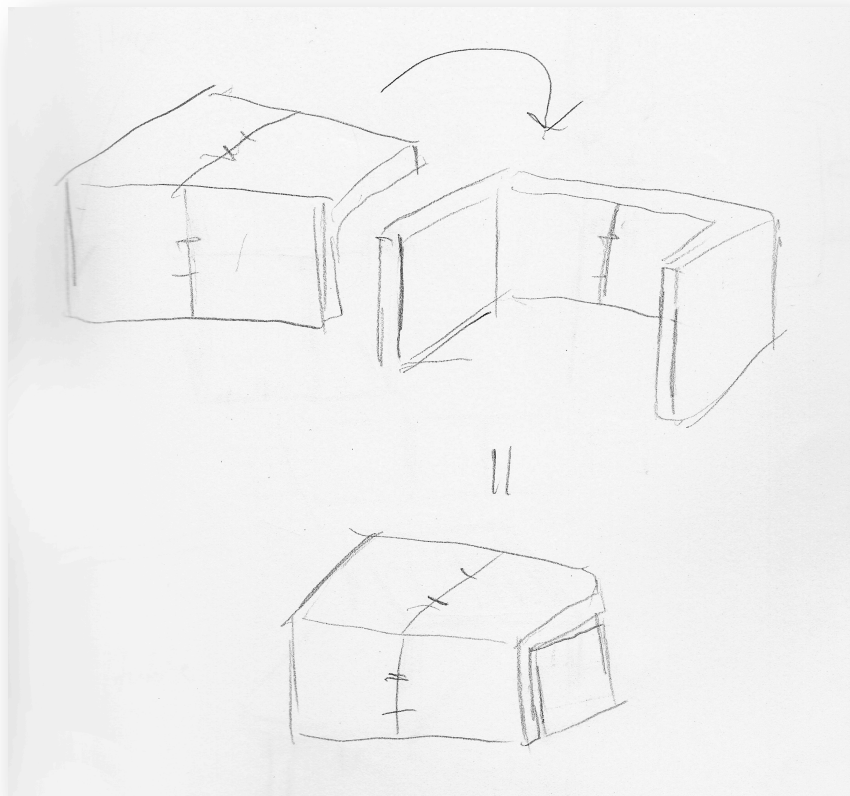
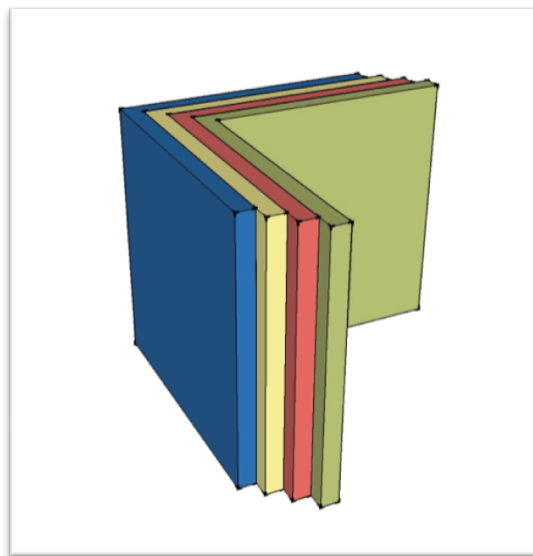
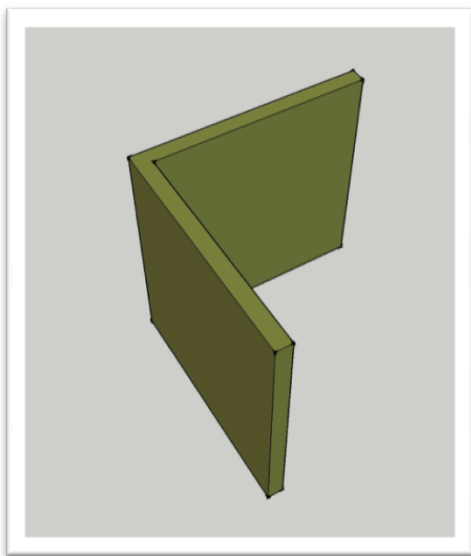


Figure 34: Sketch 14, Right Angles



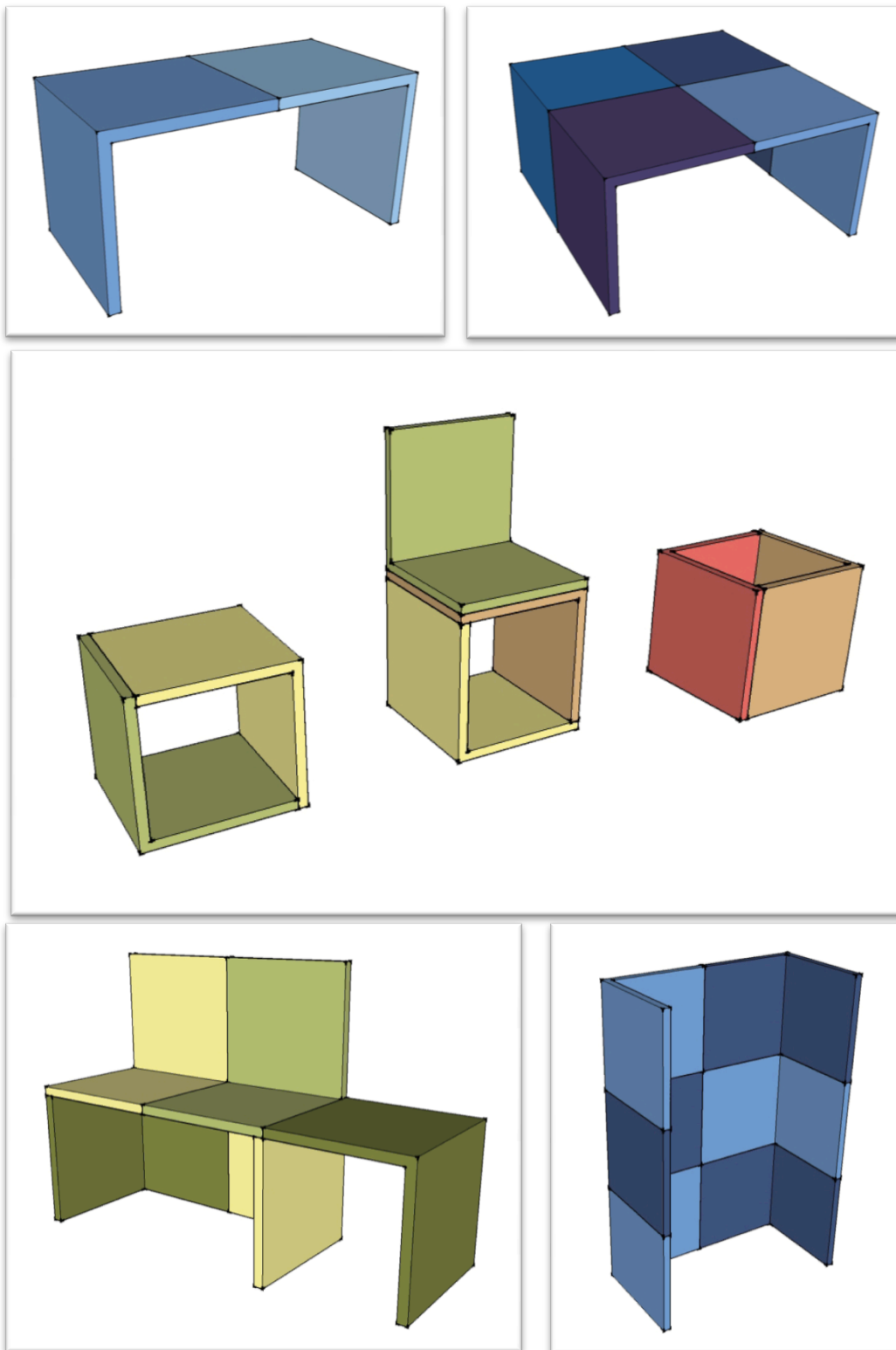


Figure 35: Render 6, Right Angles

Phase 3: Data Reduction

After discussions between the designer and the assisting professor, it was decided that the ideas must be narrowed down to only a couple ideas that could be further explored. It was determined, due to the greater amount of flexibility of use and interaction with the user, the “Wall Tiles” and “Right Angles” ideas would be best for further exploration.

One problem with the “Wall Tiles” design is that there is not a practical way to create a back to a seat. The initial design was made with a clip to connect two parallel rods together. This can pose a problem. If the clip is not tight enough, the rods could slide, and the back will not stay up. With the weight of the user leaning against it, there is more of a chance of the clip failing. Not only is the clip unreliable, but it also adds complication to assembly. This is one more added part to the design, and this complicates the user interaction.

The need for a better seat back solution was solved by a folding seat design. Stemming from the earlier folding designs, a seat back can form from a tile that splits in two and is opened with a hinge. Not all tiles would be this way, but the user could choose to buy some tiles in this manner to produce a greater variety of furniture. The splitting tile would be thicker, but this would add more dimension to the wall tile configuration when stored on the wall. This design can also allow for a softer seat and a more solid surfaced tile. The interior of the tile could contain a cushion, but when closed, only a hard exterior would show.

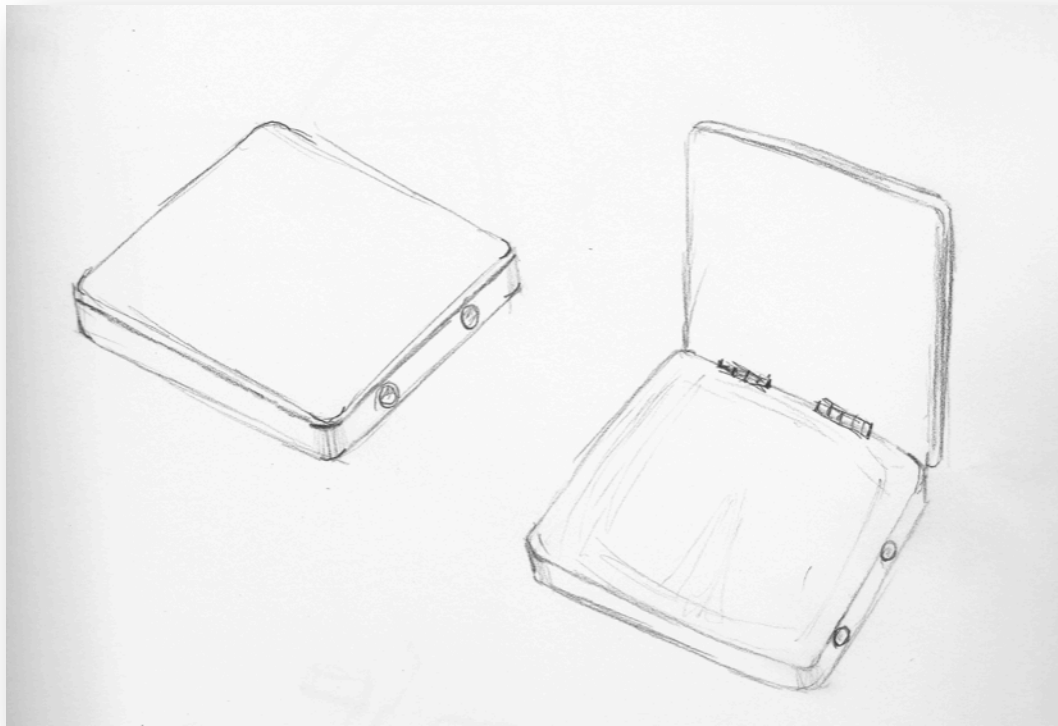


Figure 36: Sketch 15, Wall Tile Seat Back

Some other details were also explored with the “Wall Tile” design. Materials, textures, and edging were all considered. The ideas for materials of this product began with injection-molded plastic. The plastic can be of a variety of colors, and could be molded to have different textures on it as well. The plastic material is hard, which is good for table surfaces and also for stability. Another material that could be added is a foam cushion covered with a stretch fabric. This could be added to one side of the tile for seating purposes. It would also be added to the interior sides of folding tiles. With comfort in mind, another material that could substitute the previous ideas is a mesh fabric on a metal frame. Similar to some office chairs, this mesh fabric, when stretched on a

frame, is strong enough to hold the weight of a person sitting on it. It also gives a little and forms to the body. This would provide more comfort for the user.

Another way to provide more comfort, and also eliminate excess materials, is to form the tile itself to the body. Using injection-molded plastic, the mold can create a shape that is more curved and not as flat and rigid. This idea to create a seat indent could also create more variety and depth to the “Wall Tiles” when stored on the wall. The curve of the indent can be rotated in different directions, just as typical wall tiles are configured.

Not only was the shape of the surfaces explored, but the edging style was experimented with as well. The edges should not be rigid right angles, because this would not be comfortable to sit on. A softer edge would be more desirable, and also more interesting as a piece of wall art. Some ideas were played with to find a design suitable for both furniture and a wall tile.

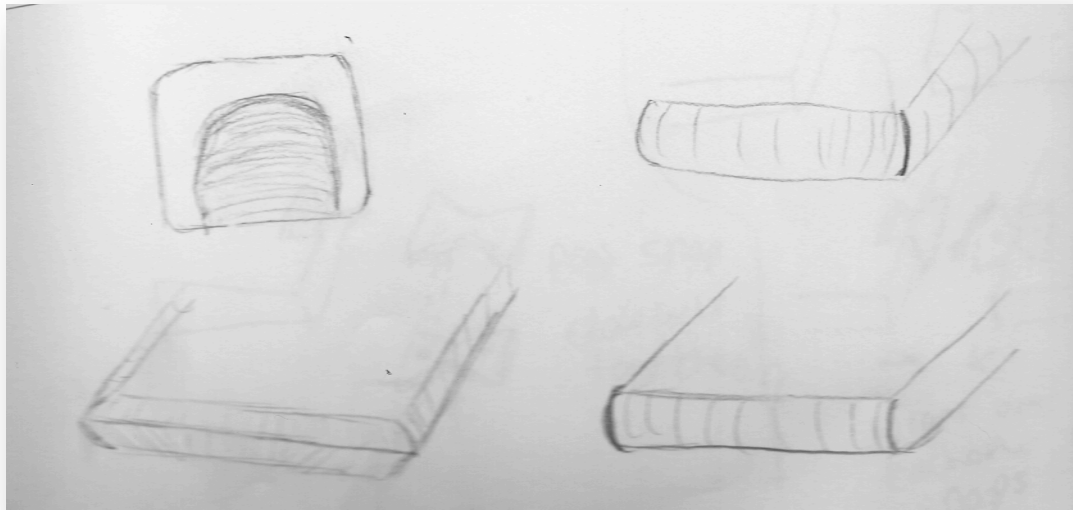


Figure 37: Sketch 16, Wall Tile Edge Styles and Seat Indent

While experimenting with the “Wall Tiles,” the designer also began to work out some details with the “Right Angles.” At this point, there were configurations of “Right Angles,” but there was not a way to connect the pieces. There had to be some form of connection on the edges of the “Right Angles.” The pieces must also be able to connect at the edges when parallel in the same plane, and several ideas connecting the components were explored. The first was an H-shaped clip that could slide into grooves pre-cut along the edges of the “Right Angles.” Another idea was to use a dovetail to join the pieces because a dovetail joint would provide a stronger connection. Two types of dovetail connections were created. One is made of two pieces that snap together on either side of the connecting planes. The other is a dovetail groove cut into the “Right Angles” with a rotating dovetail that folds over onto the connecting piece. The latter of the two was too complex, so the designer decided to move forth with the dovetail snap.

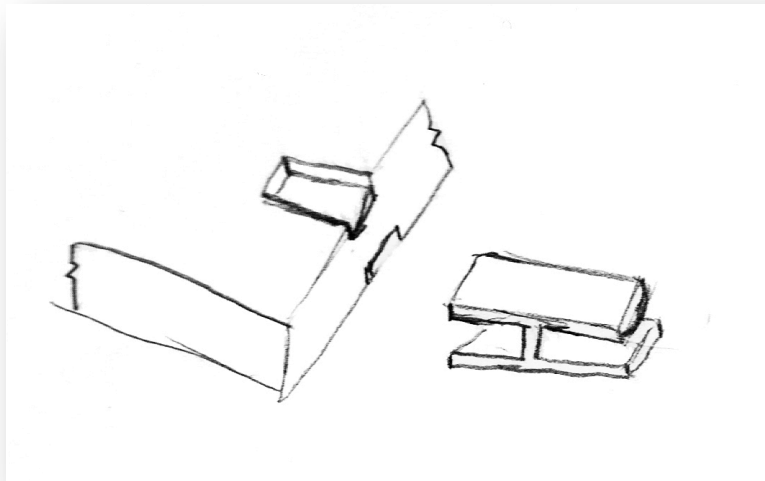


Figure 38: Sketch 17, H-Clip Connection

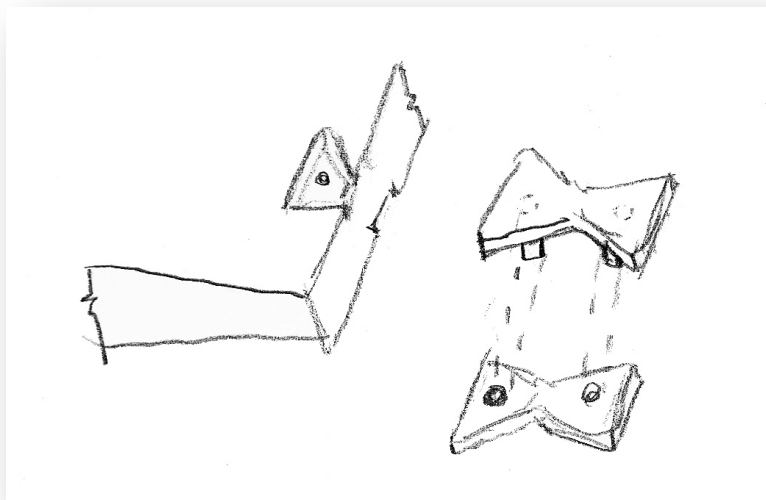


Figure 39: Sketch 18, Dovetail Clip Connection

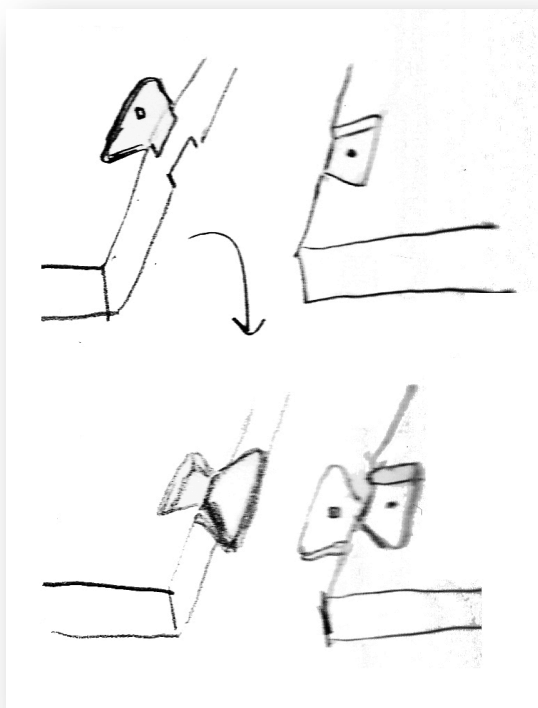


Figure 40: Sketch 19, Folding Dovetail Connection

At this point, the designer had to decide on one product to further develop. After discussions with a professor, it was decided that the “Right Angles” design would be best to further develop. This design is less complex. The user does not have to worry about sliding the tiles on poles, or opening up the seat. This design simply consists of an orthogonal form and the connector pieces. The angle itself provides the support and does not need an added metal pole. There may also be issues with the joint in the pole.

The “Right Angles” design also allows for many more variations of furniture types. With the “Wall Tiles,” there is a limit to the length of the pole and where the tiles can connect, but the possibilities are almost endless in configuring the “Right Angles.” The user has more creative freedom with this design.

Halfway through the design process, the “Right Angles” design has been chosen for further development and has been formed into the following. There are connection points along all sides of the components. There is a dovetail shaped groove cut into the connection point, and a hold is drilled in the center of this. This allows the dovetail snap to connect the pieces and remain flush with the surface. The plastic is also translucent so the connection points create a more interesting detail of the piece.

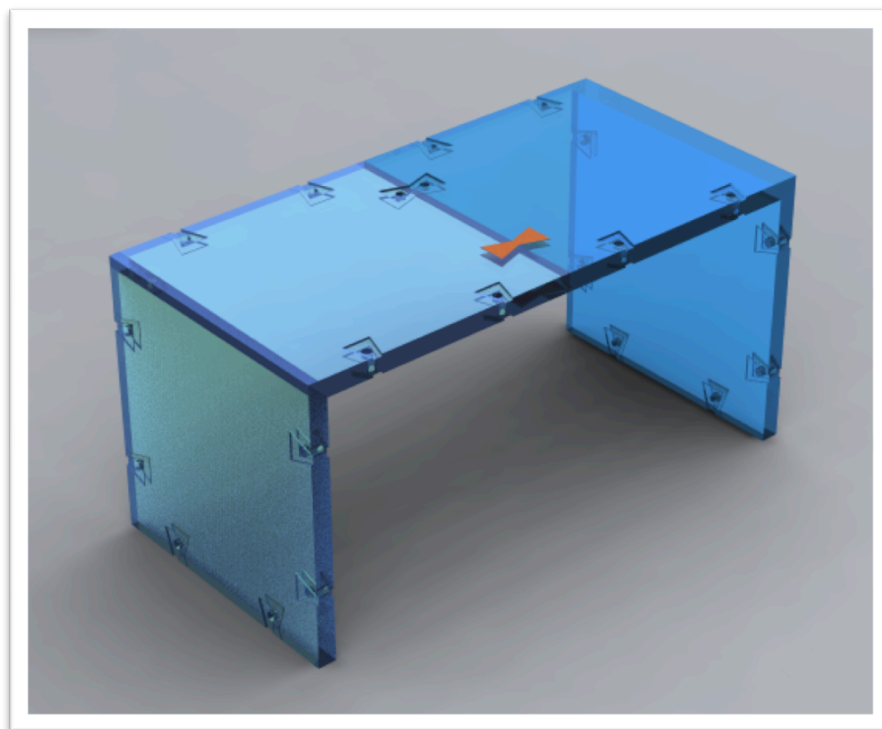
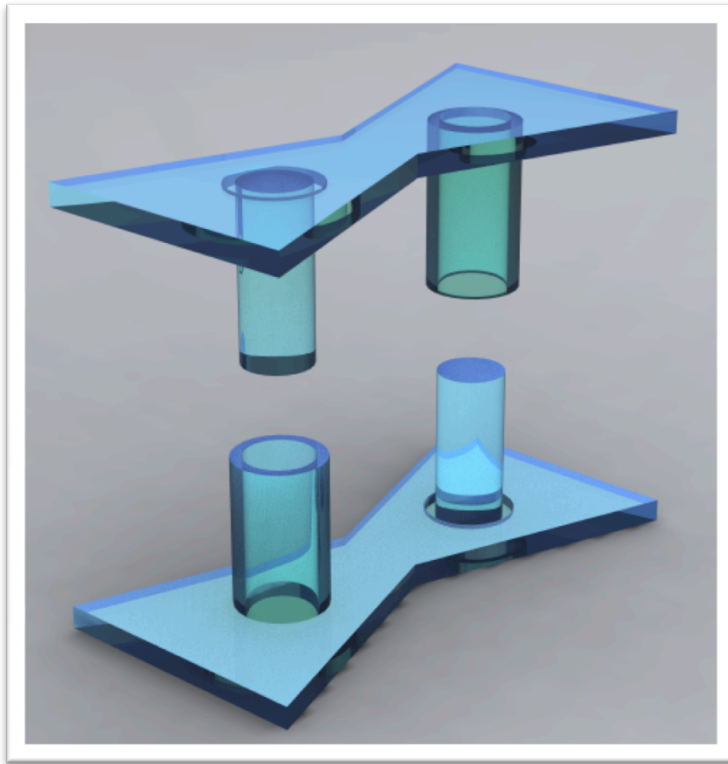


Figure 41: Render 7, Right Angles with Dovetail Snap Connection

Phase 4: Testing

The next stage of development is testing. While the design looks nice on paper and in 3D on the computer, it does not mean it will work in real life. The design must be tested to see if it will actually work. Due to limitations of machinery, materials, and cost, the design could not be tested in the intended injection-molded plastic. Therefore, any testing was simulated with MDF and wood materials, as well as metal hardware.

Testing began by building full-scale “Right Angles” out of 3/4” MDF. Because the wood could not be formed as a single orthogonal piece, a dovetail joint was used at the angle and was reinforced with nails. This joint would compliment the dovetail connection, so these dovetails were cut to be in line with the connection points across from them. The designer used a band saw and a hand saw to form the dovetail joint.

For the dovetail connection points, the designer used a router to cut away the grooves for the dovetails. Because of the substituted material, the dovetail snap could not be created as planned. Wood would be too fragile for such thin components. A similar idea was formed to simulate the original plan. Only one side of the snap was created with two pegs that would fit into holes in the grooves. This was made with a 3/8” MDF, so it would only be half the thickness of the MDF right angle. The dovetail could be easily removed by pressing up on the pegs that slightly protrude from the bottom side of the right angle.

When assembled, the piece held together on its own. Unfortunately, it was wobbly and could not hold much weight. Because there was nothing bracing the bottom

of the joint, as in the original “dovetail-snap” idea, the joint would bow inward. It was obvious that the wooden pegs were not strong enough to hold the pieces together.

To further test the dovetail idea, the designer made a new dovetail with holes instead of pegs. These holes lined up with the holes in the dovetail groove. This allowed for the dovetail to be bolted into place. When assembled, it was much sturdier, but failed when sat on. The MDF was not strong enough to withstand much weight.

To test a sturdier material, the designer created the same dovetails out of wormy maple. This wood is a much stronger material than MDF. When bolted in place, these dovetails could withhold the weight of the designer sitting on it, but it was unsure if they could endure much more weight.

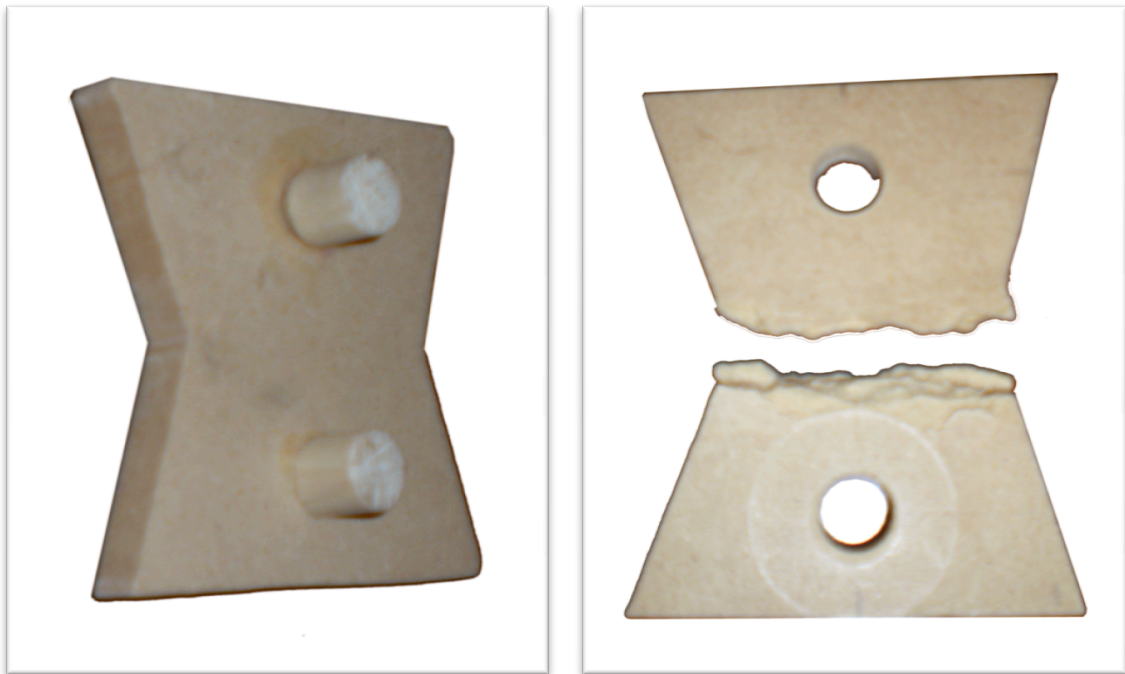


Figure 42: Photo 1, MDF Dovetail with Pegs and MDF Dovetail with Holes



Figure 43: Photo 2, MDF Right Angles with Warmy Maple Dovetail Connection

To find a stronger method of connecting the “Right Angles,” the designer decided to test a metal connection. The MDF “Right Angles,” from the previous test would not work for this test, so the designer rebuilt the pieces with new MDF. Using prefabricated metal straps and angles from the hardware store; the designer secured the pieces together with screws and this metal hardware. The metal angle was used at the right angle joint so it could hold more weight. The two metal straps were bolted to the center connection for a stronger joint, and also to spread out the force exerted at the center point. When sat on,

this method proved to be much stronger. The center was strong and sturdy. However, the angles were not as stable. They did not break, but a stronger connection would be needed to keep the piece sturdy. This test proved that metal would be a good solution for connecting the “Right Angles.” Also a permanent connection in each angle would be best to keep the joint stable.

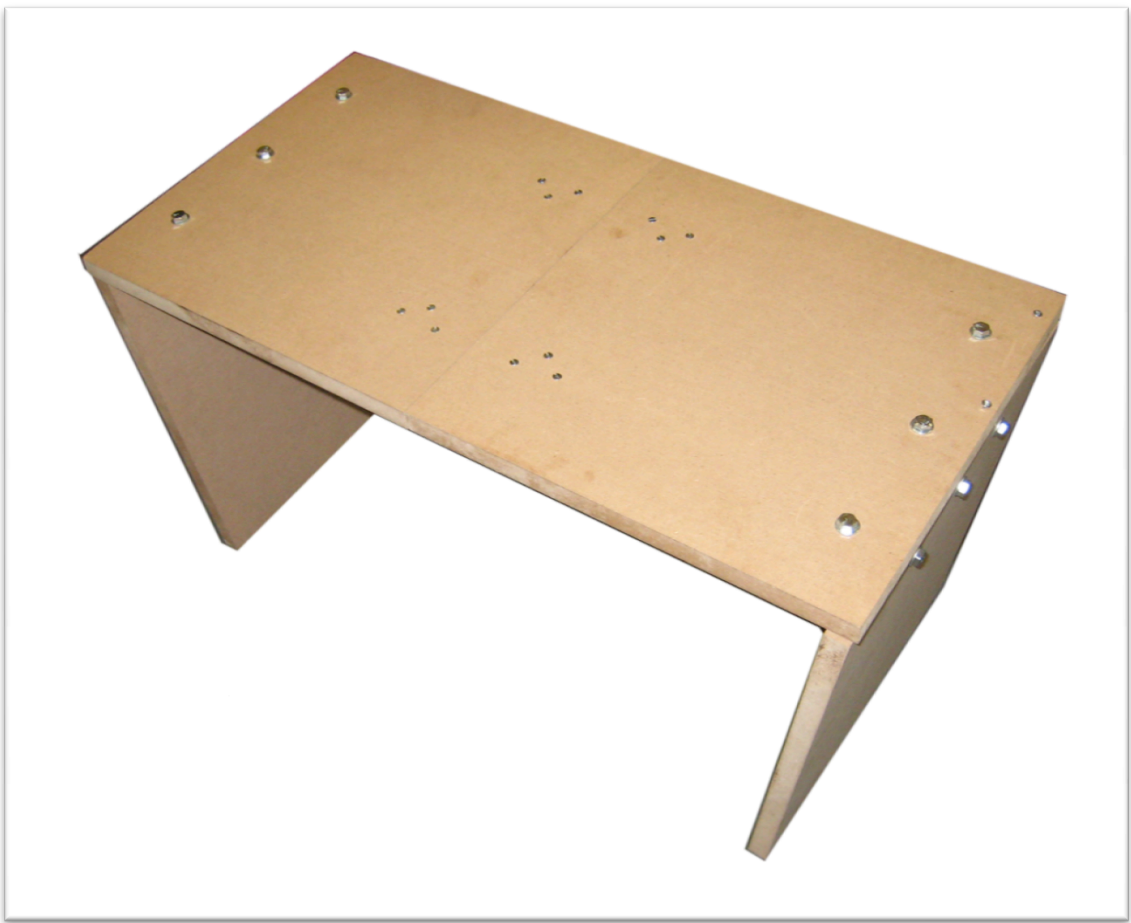


Figure 44: Photo 3, MDF Right Angles with Metal Connection

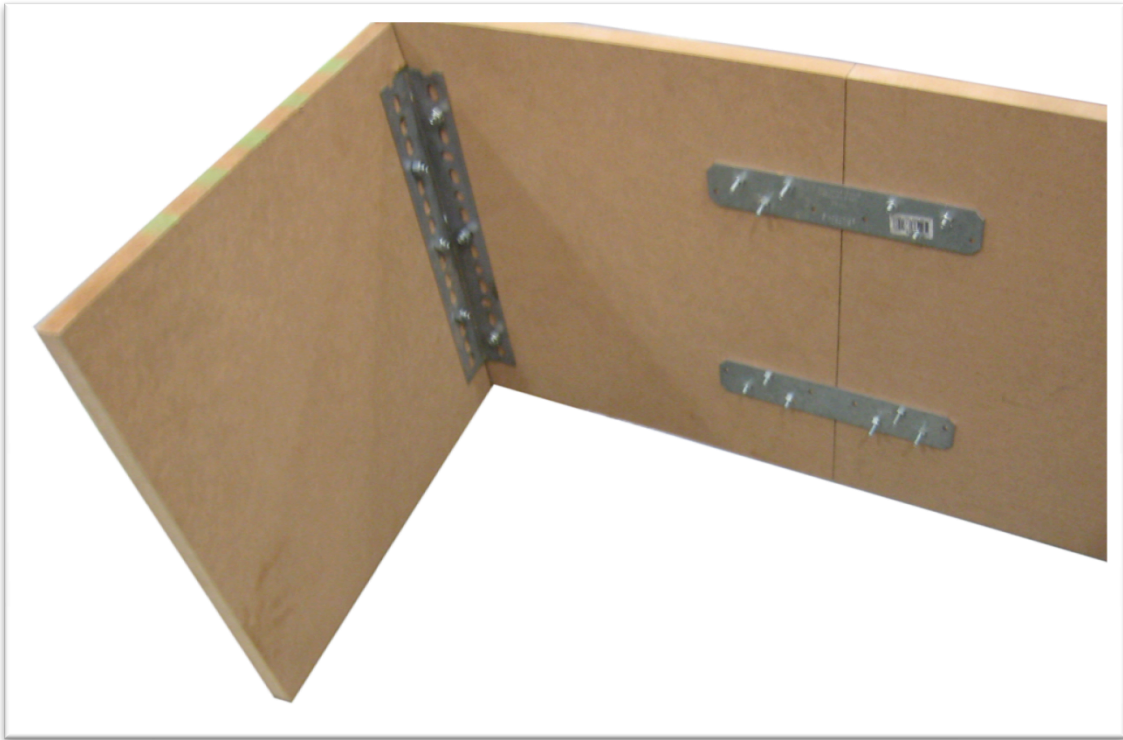


Figure 45: Photo 4, MDF Right Angles with Metal Connection

In order to have a strong connection at the joint between the two pieces, the connector must be made of metal. The metal piece must spread across the length of the slab, in order to spread out the force of weight in the center of the joint. Therefore, a longer metal hardware helps put less stress at the point of connection, thus reducing the possibility of the joint failing. The metal connector also rests on the underside of the seat. This further eliminates the risk of failure in the joint.

Using the information gathered from testing, along with some knowledge of physics, the designer needed to develop a connection that uses the same properties as this method, but is also more appealing.

Phase 5: Working Out the Details

After testing, the designer developed a revised design using metal connectors and a fixed angle. Included in the new design were two additional sizes. This not only opened up more possibilities for configurations, but connecting the angles asymmetrically will take the central force off of the joint. Therefore, if the connection is off center and a person sits in the center, they will not be sitting directly on the connection point.

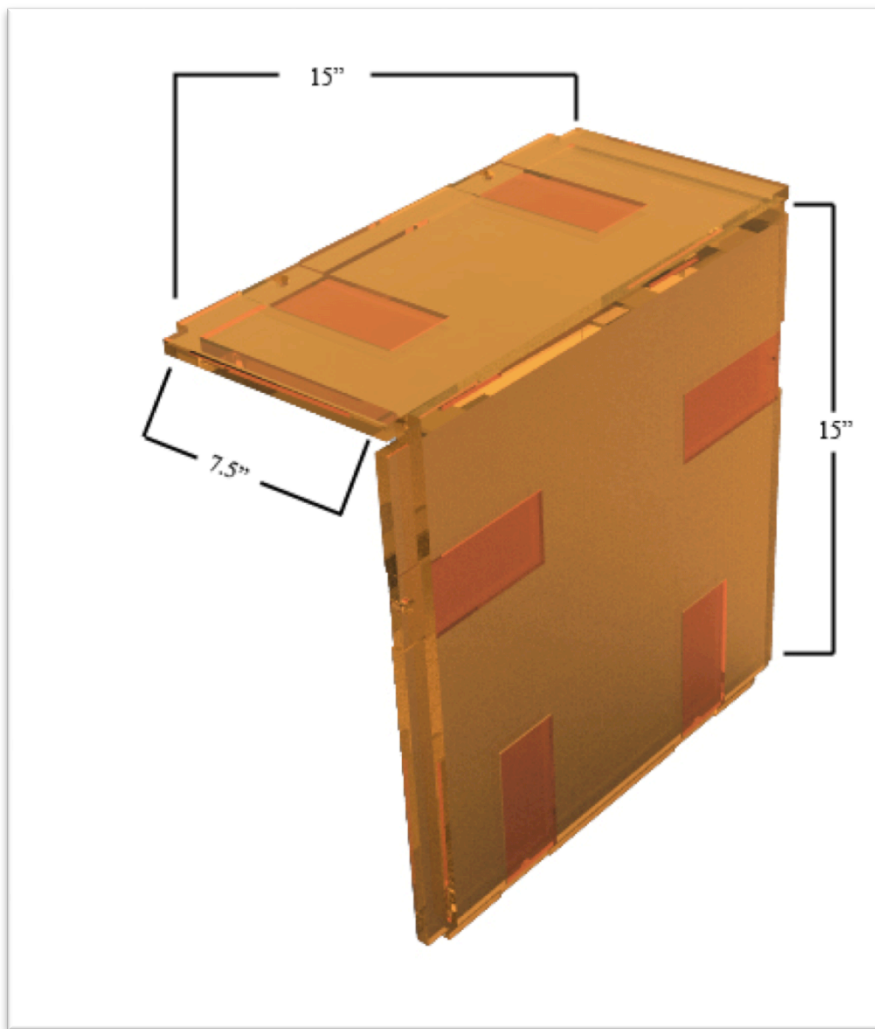


Figure 46: Render 8, Small Right Angle

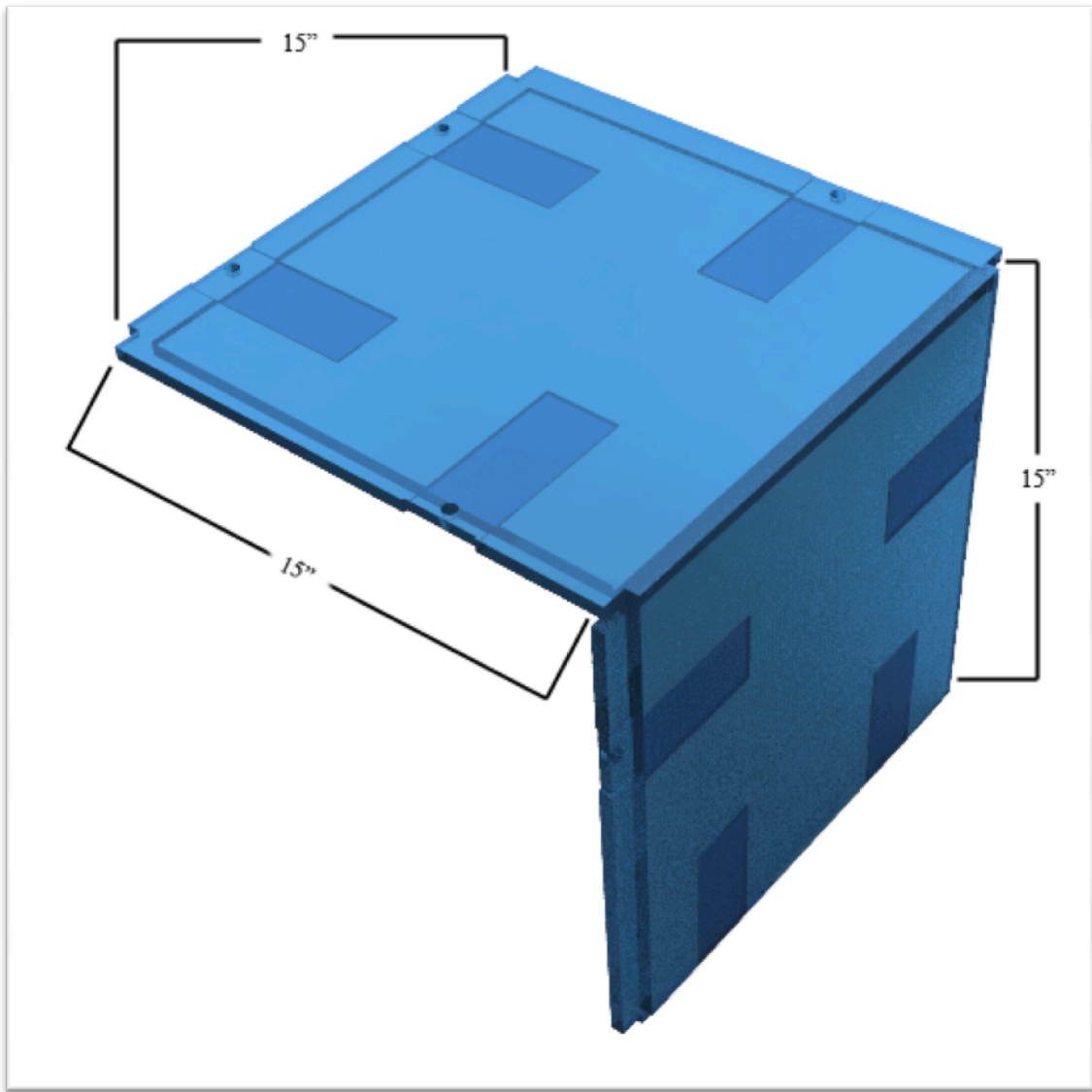


Figure 47: Render 9, Medium Right Angle

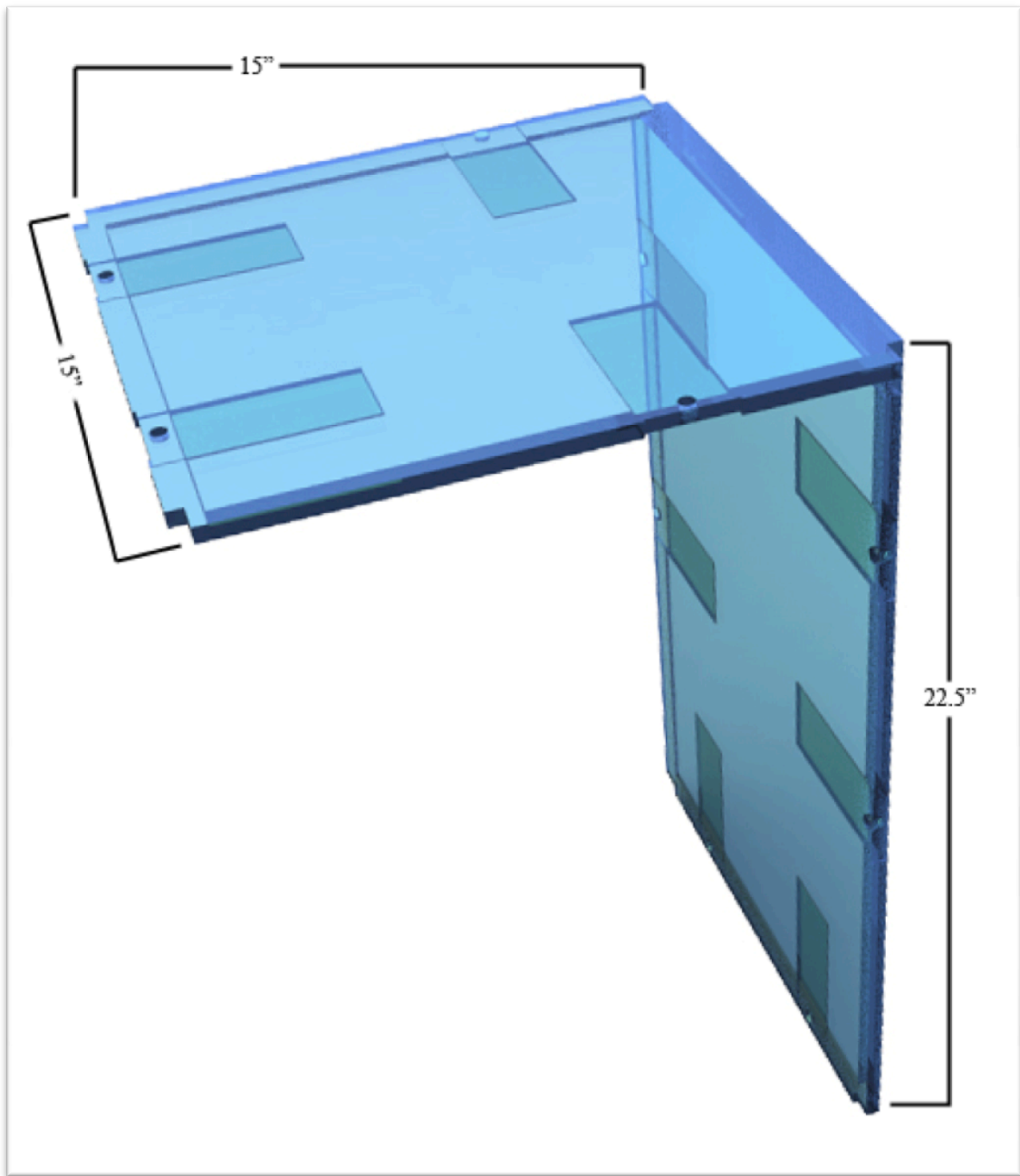


Figure 48: Render 10, Large Right Angle

Each of the three sizes is made of a translucent plastic of various colors and is fixed in an orthogonal position. The plastic can be injected into a mold shaped as the

“Right Angle,” and no connectors will be needed to join two slabs into this form. This method makes the angle stronger than if it is made of multiple components.

Around the edges of the “Right Angle,” there are slots molded into the sides to allow for the metal connectors. Also around the edges, there is an overlap of material. Each “Right Angle” has the overlap on the outer side of one plane and the inside of the other plane. The overlap is designed to strengthen the joint when connected to another piece. The connecting bolt will pass through a layer of each “Right Angle,” as well as the metal connector. The overlap makes it so that there is not one straight crack at the connection point, thus making the connection stronger. This also helps eliminate any shifting.

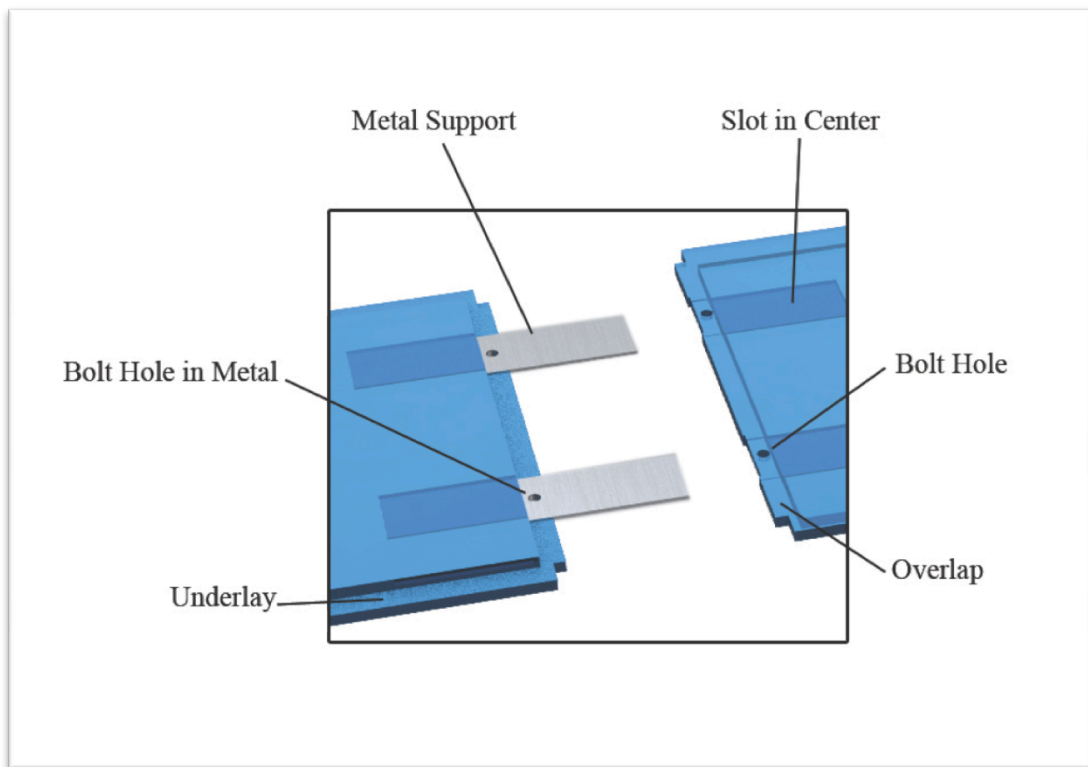
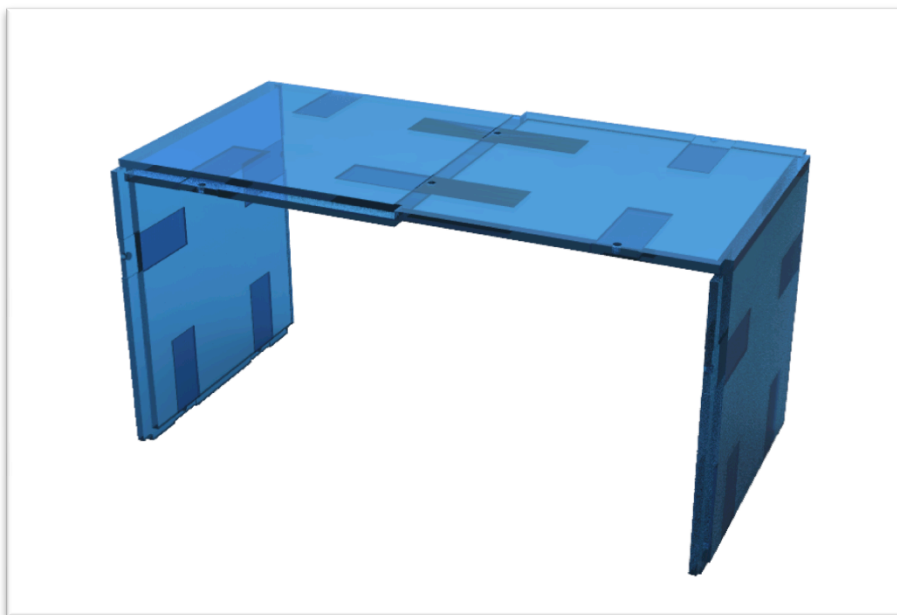


Figure 49: Render 11, Connection Detail

This form of connection (below) is used to connect planes that are parallel to one another. To connect the pieces this way, the metal piece is inserted into the slots of both “Right Angles.” One plane will overlap the other. The holes in each piece and the metal piece will line up, and a small bolt can connect the pieces and hold them in place. Each “Right Angle” is designed to have one side overlap the other. Therefore, the pieces can be rotated to connect with others properly. The asymmetrical components can be made in two ways so that there are overlaps on both lengths. This design also has indents on the corners so that the “Right Angles” can be connected on the ends and on the sides, so that the overlaps do not collide.

The “Right Angles” can be connected symmetrically and asymmetrically. If the connection is placed to the side, as shown on the right, the force will not be as strong at the connection. This form is one of the most basic, yet it is the most difficult connection. This configuration can be used as a table or a bench.



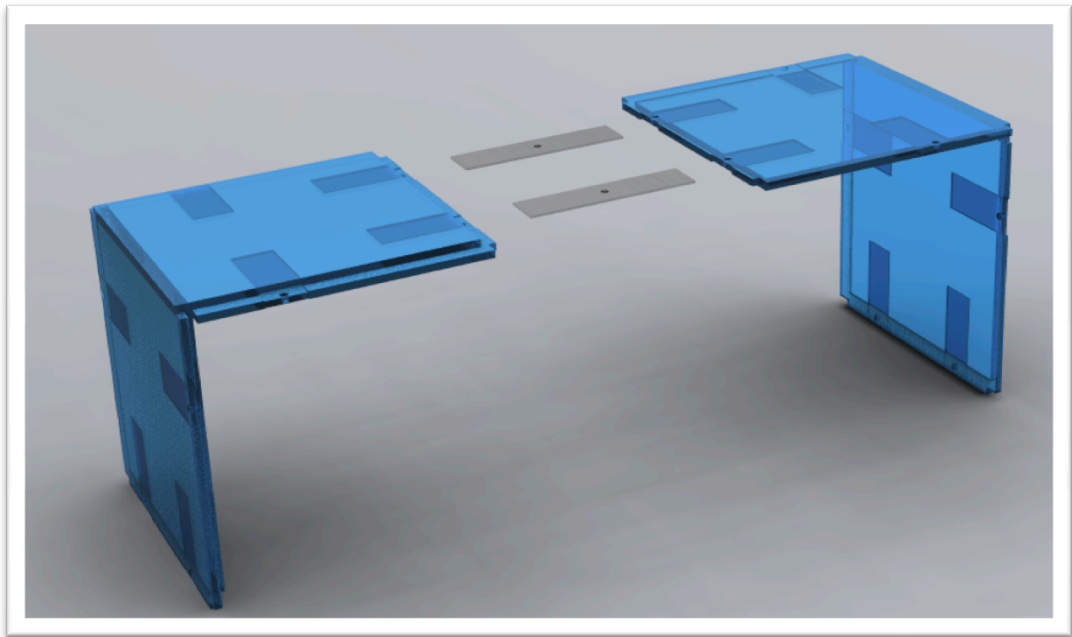
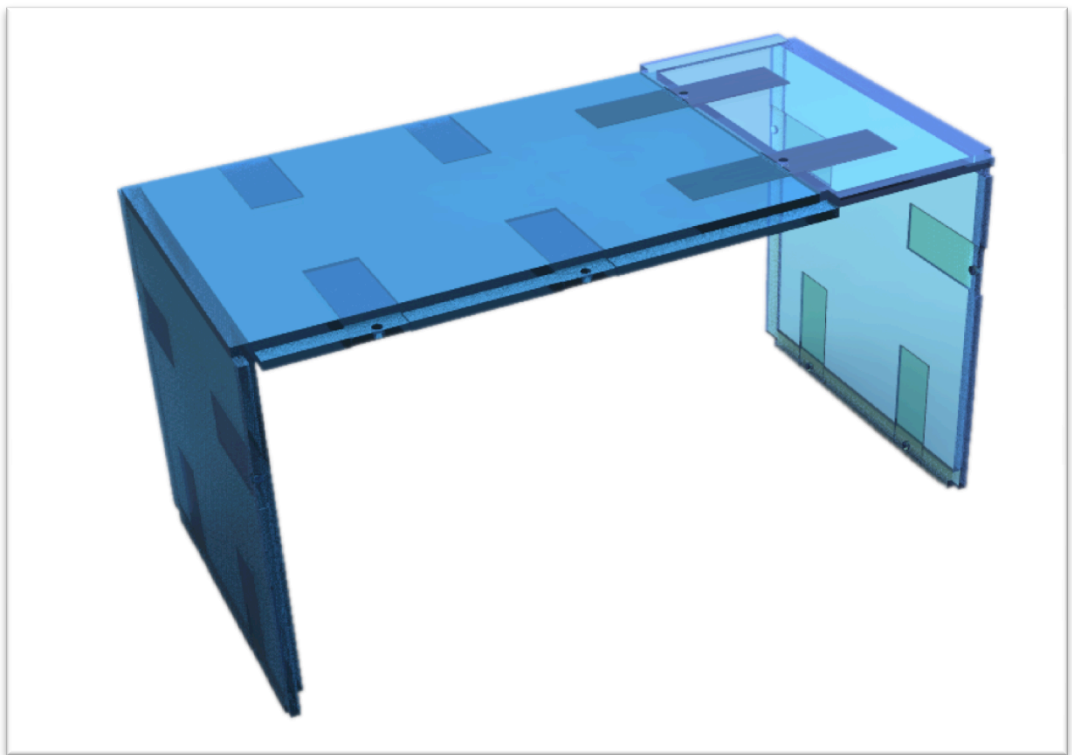


Figure 50: Render 12, Connection of 2 Medium Right Angles



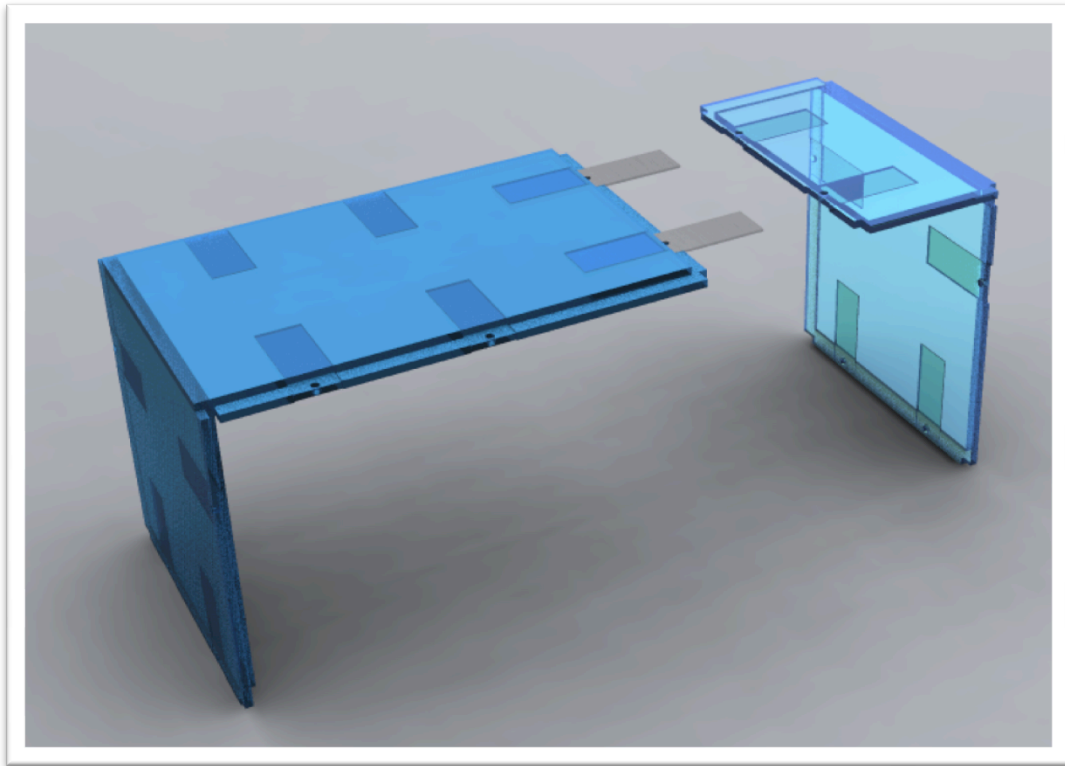


Figure 51: Render 13, Connection of a Large and Small Right Angle

Another way to connect the “Right Angles” is perpendicularly. This forms a cube shape and is stronger than the parallel connection. A different type of metal connector is used to connect the pieces this way. To form this cube shape, the metal connectors must first be inserted into the “Right Angles” on the same axis. Then they can be inserted on the second axis. The connection will not work properly if the metal connectors are all inserted into one piece before the other. The cube shape can also be used as a table or as seating. This shape is also good for stacking and storage. This formation is stronger than the other, and can even be used as a base for a glass table or, when placed in a group, a platform for a mattress.

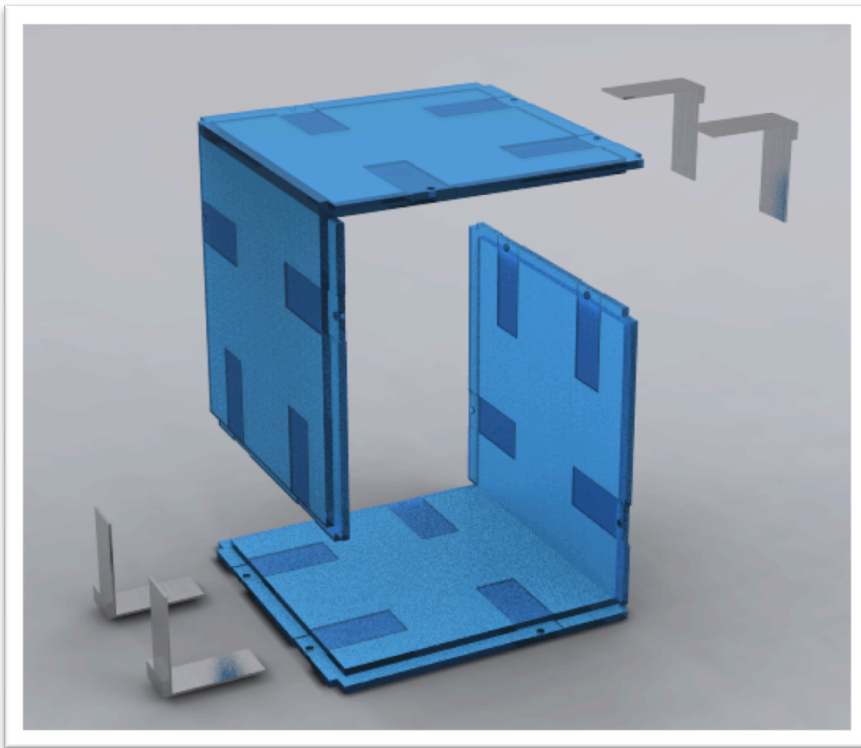


Figure 52: Render 14, Perpendicular Connection



Figure 53: Render 15, Cube Shelves

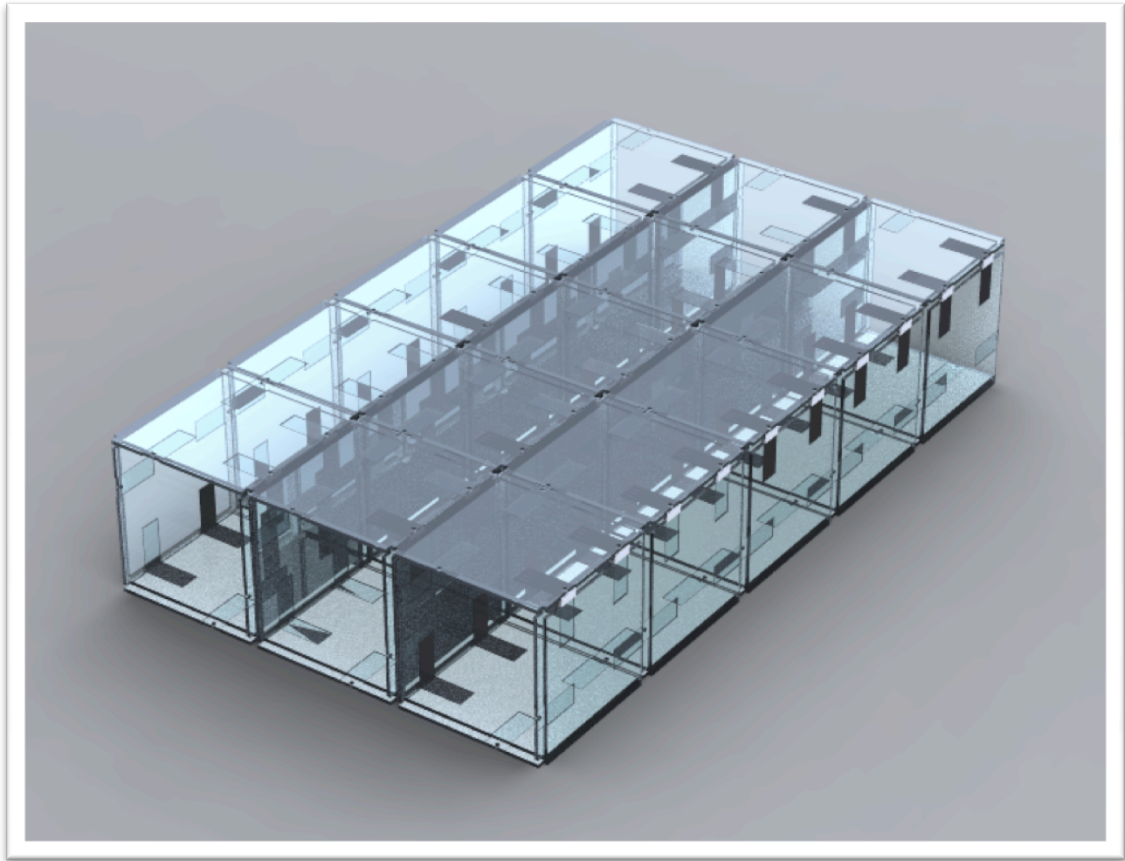
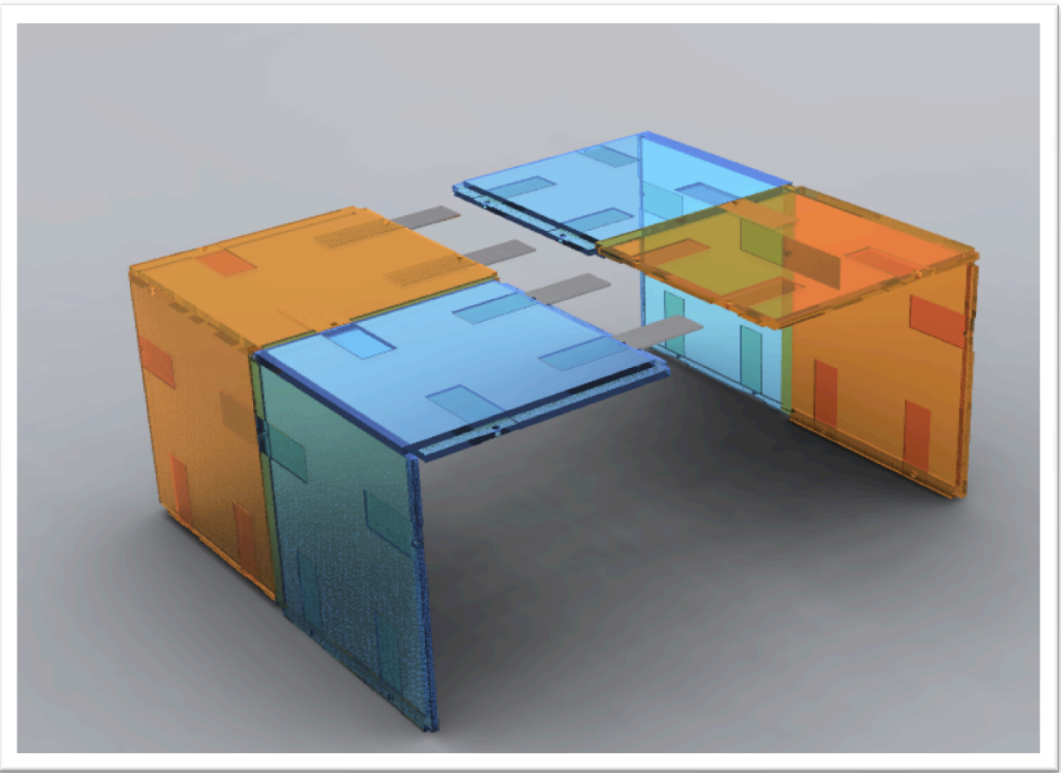
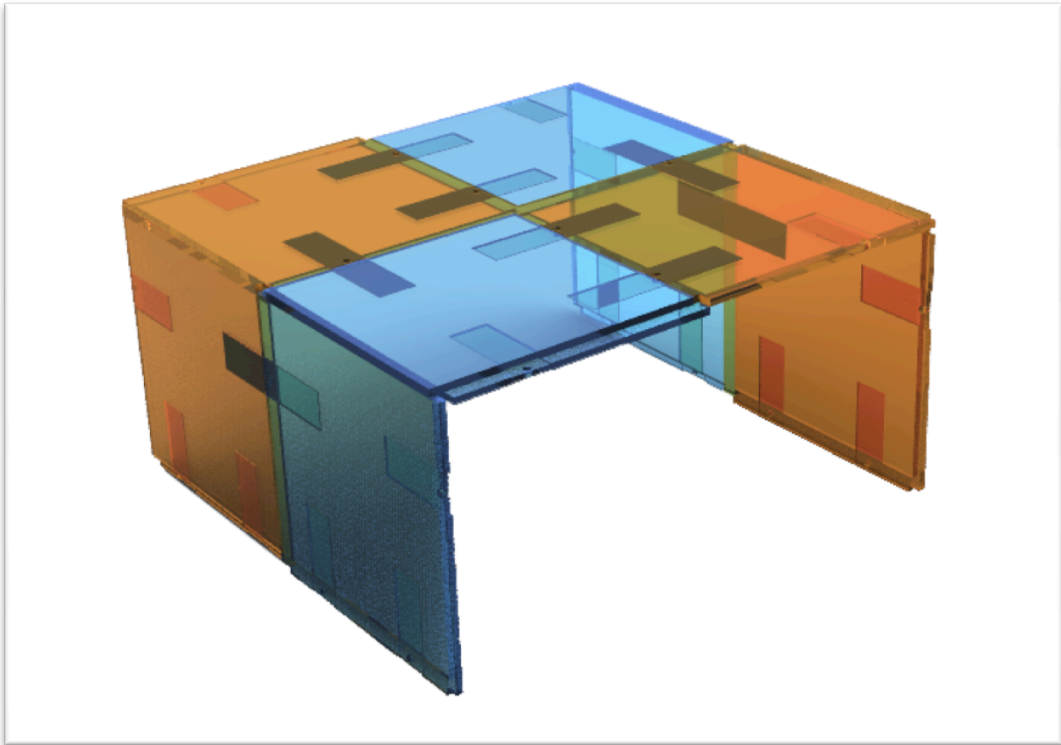


Figure 54: Render 16, Bed Platform

The configurations do not end with a simple two-piece connection. Many “Right Angles” can be connected to form other furniture pieces such as tables. Even more pieces can be added to increase the height of a table, transforming a coffee table into a dining table or console. Using different sized “Right Angles” can help vary the table shape and help personalize the product. Users can also use their creativity by experimenting with color combinations. Both size and color can alter the effect of the final product.



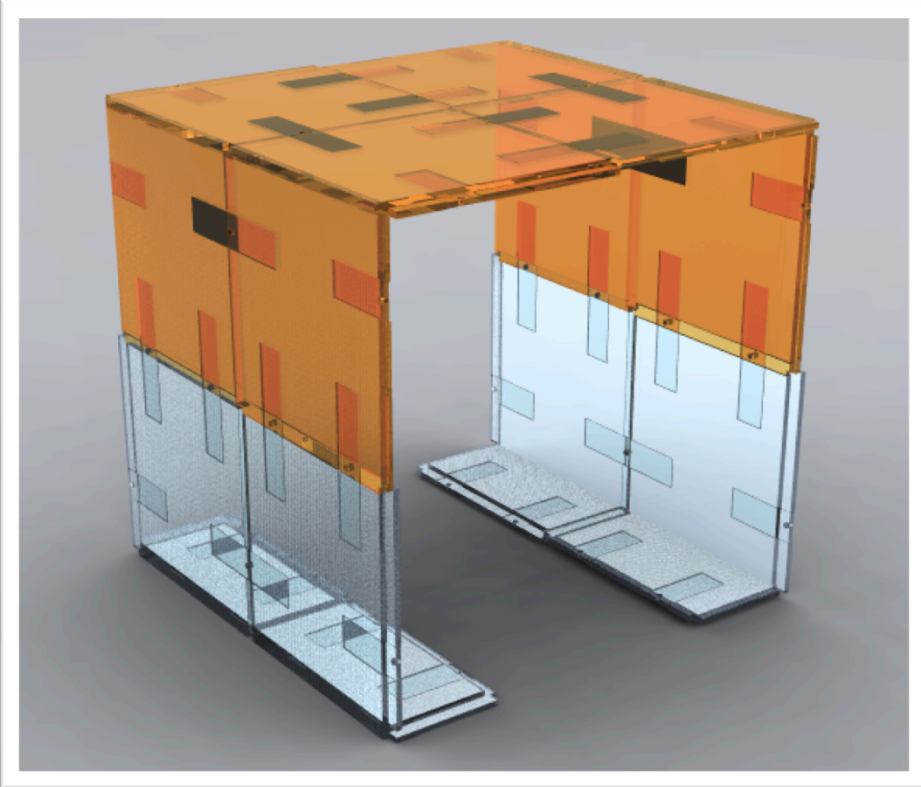
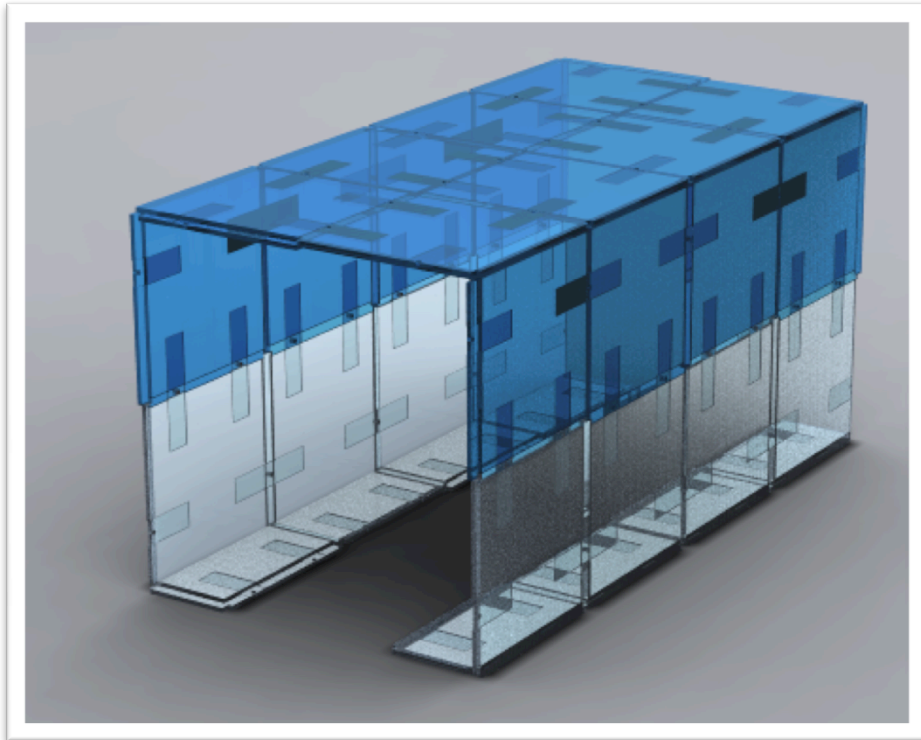
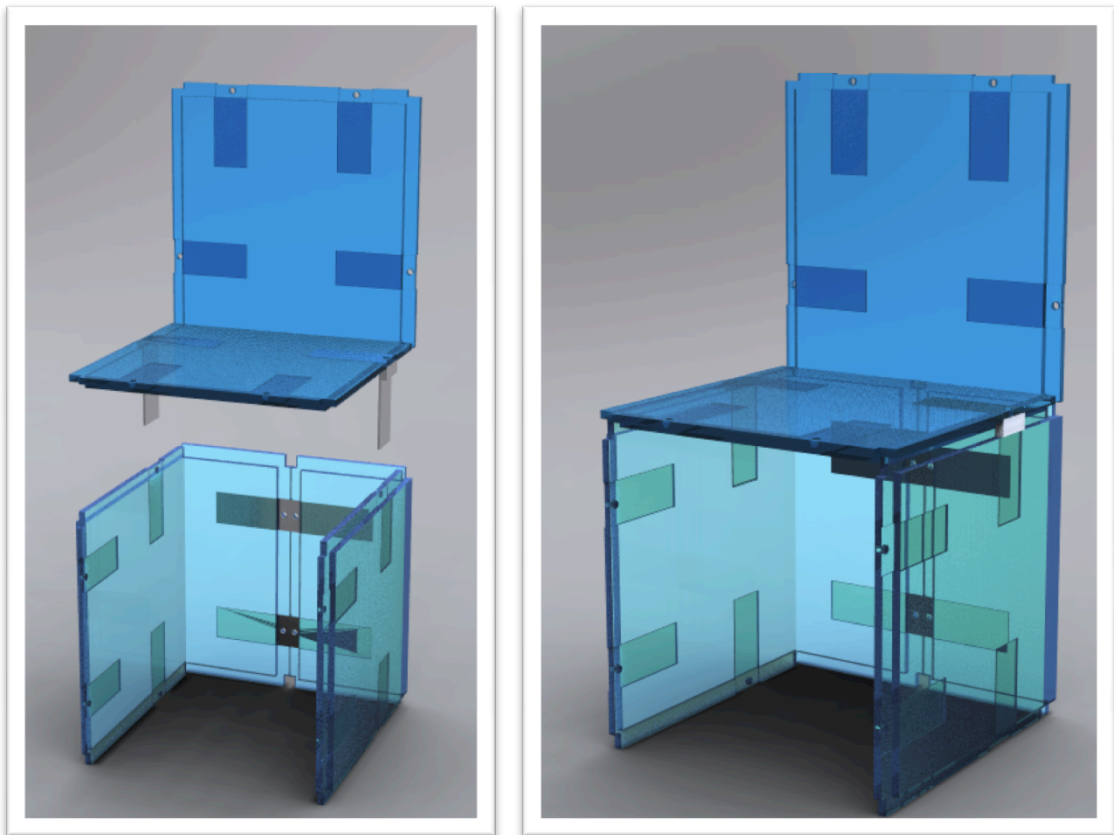


Figure 55: Render 17, Table Configurations

Tables require a straightforward connection, as the pieces are connected with only the flat metal connector. Seating with a back, on the other hand, uses two forms of connectors. The base of the chair uses two small “Right Angles” connected on the short ends to form a three-sided square. This square is turned on its side to provide a strong support for the seat. Then, the bent connectors are used to connect a medium component to the top of the square as the seat and back. It is recommended that the back be placed above the connection end of the square. This provides support for leaning back, and also allows for feet space at the front of the chair. By using larger angles as a base, seating can be made wider for two people.



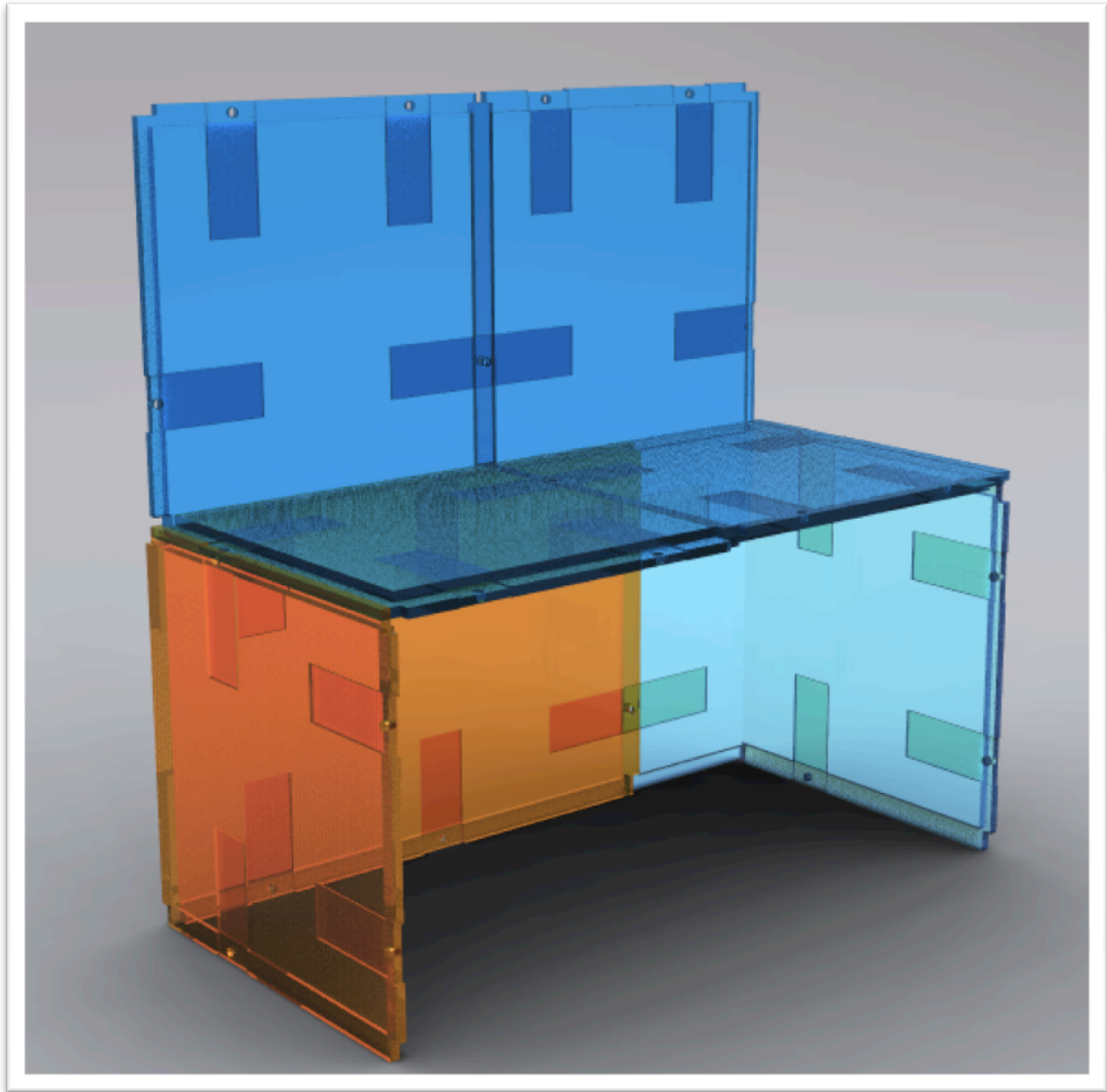
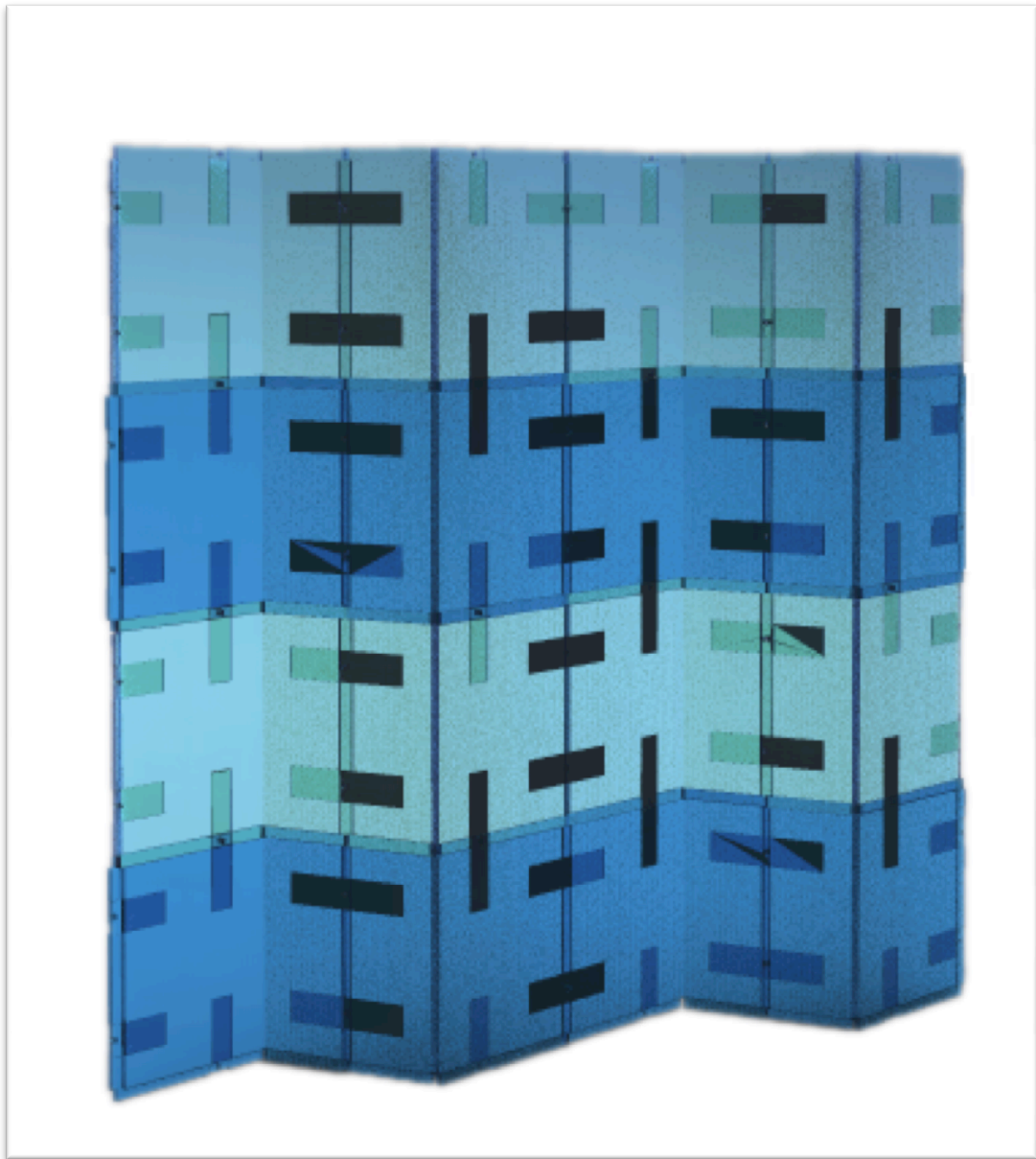


Figure 56: Render 18, Seating Configurations

To further personalize a space and express creativity, the user can also use the “Right Angles” to create room dividers or all shapes, sizes, and colors. A solid wall of “Right Angles” can create areas within a small space, but the translucency of the plastic will still allow light to pass through and also create a connection between the areas. Thus, because of the translucency, room dividers made of “Right Angles” will not close in the

space and make it smaller than it already is. Using lighter colored pieces with more transparency can also help save space. The ability to alter the room dividers makes it easy to change a space and make it form to the needs of the user.



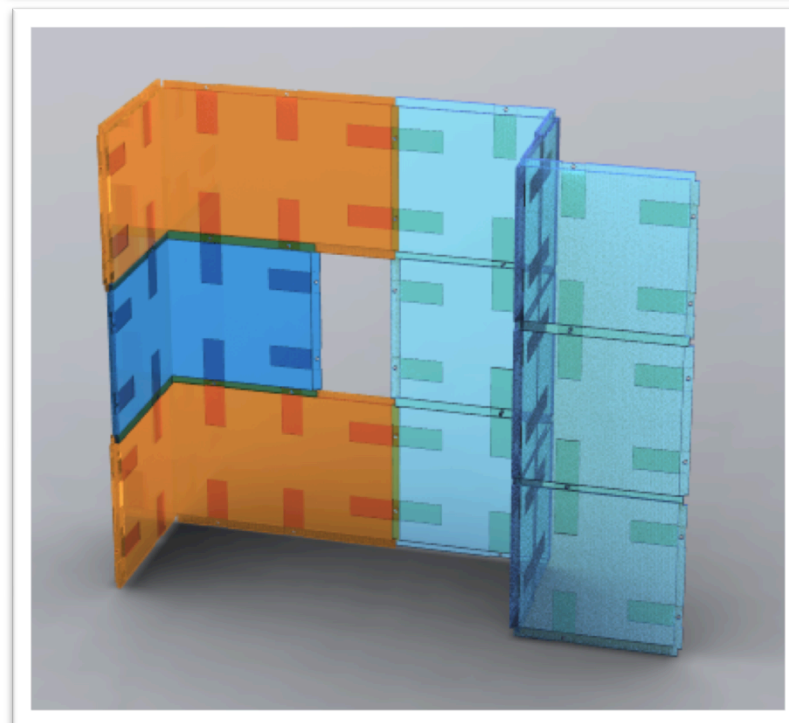
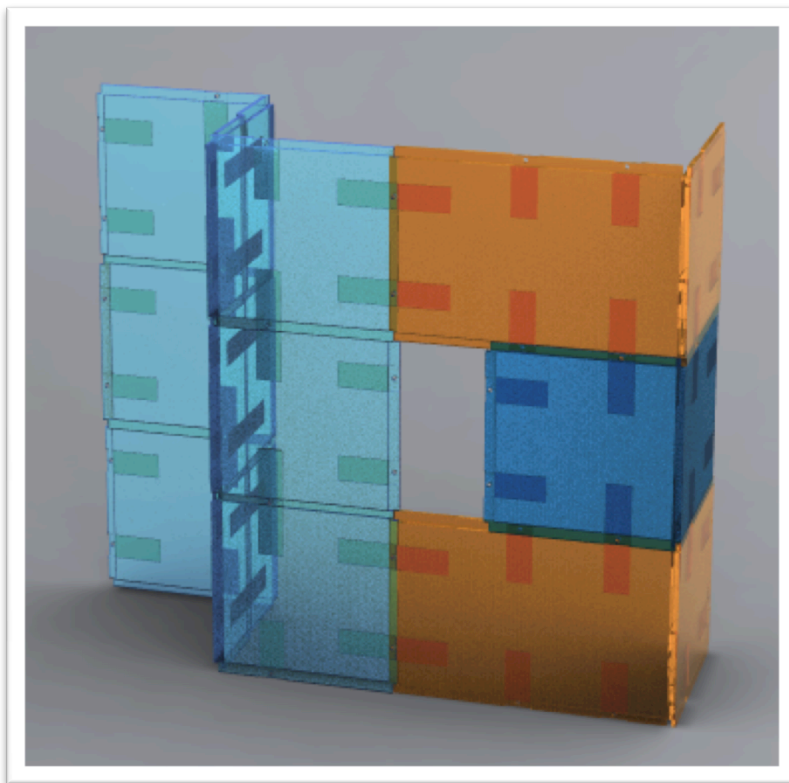


Figure 57: Render 19, Room Divider Configurations

Phase 6: Constructing a Prototype

After developing the product with 3D Digital modeling, it was time for the designer to develop a full-scale prototype of the “Right Angles.” However, there were some limitations when building the prototype. Due to the high cost of developing a mold for the plastic, as well as commissioning someone to produce the product in the proposed method, the designer had to make some adjustments in materials. Instead of building the prototype in plastic, as intended, the designer used a substitute material, wood.

It was decided that wood would be the best material for producing this prototype. The designer had some experience in working with wood, and there was also a woodshop available to the designer. Wood also has the characteristics of being solid and rigid, like the plastic. Unfortunately, it could not replicate the transparency of the plastic. In order to have a durable product, unlike the MDF testing prototypes, the designer used Baltic birch plywood for construction. This material also has a nice smooth finish, unlike a typical building supply plywood.

By choosing to use this material for constructing the prototype, some other adjustments had to be made in order to produce the intended form. First of all, the wood could not form a perfect 90-degree angle with only one piece of plywood. The wood could not be injection molded like the plastic, so the “Right Angles” had to be assembled from two slabs. Therefore, there had to be a joint at the angle. The designer decided to use a lap joint secured with wood glue and finishing nails. The lap joint provides more surface area for the glue to join the wood. It also provides a connection two planes to further the durability. (See Appendix B)

Another necessary adjustment was in the construction of the connection slots. It would be very difficult to create the thin slots on the edges of the angles with the tools offered in the wood shop. To make the slot construction possible, the designer decided to use two pieces of plywood glued together to form the single slab. Slots could be cut into the surface of the plywood prior to gluing.

The last adjustment came with purchasing the plywood. To create the proposed product, the slabs should be 3/4" thick. This would mean that each layer of plywood would have to be 3/8" thick. When the designer purchased the Baltic birch plywood, only 1/4" and 1/2" plywood were available. The 1/4" was thought to be too thick and could break more easily. It may also splinter when routing out the slots. Therefore, the designer decided to work with the 1/2" plywood. This would increase the thickness of the slabs, so all of the measurements must be adjusted to suite the new thickness.

The designer began production with a test piece made of cheaper plywood. This was to test the cutting techniques and verify that the measurements were correct to make the pieces fit together. This process also included learning the tools in the woodshop. While the designer was familiar with the table saw and band saw, the router was a new device. The designer learned to use the router and learned how to make a template. The test plywood was used to practice with the router and make sure that the designer could create the slots using the router. All of the tests proved to work well, so the designer was ready to construct the final product with the Baltic birch.

The process began by cutting the plywood into squares and rectangles of the appropriate sizes. This was done with the table saw. The designer then cut out the indents

in the corners with the band saw. The designer marked the area for the slots, and with a router, routed out the area at 1/16" deep. To make the corners sharp, instead of the rounded out corner resulted from the router, the designer chiseled the remaining wood from that area. When all of the cuts were complete, the designer sanded the any rough edges.

Next the pieces had to be assembled. The designer used wood glue to join the two layers of plywood. The glue was applied to the routed out side of the plywood and the two pieces were pressed together with the routed grooves in line. When everything was lined up, the designer placed clamps around the edges to hold the pieces in place while the glue dried. Due to a limited supply of clamps, only one slab could be assembled at a time.

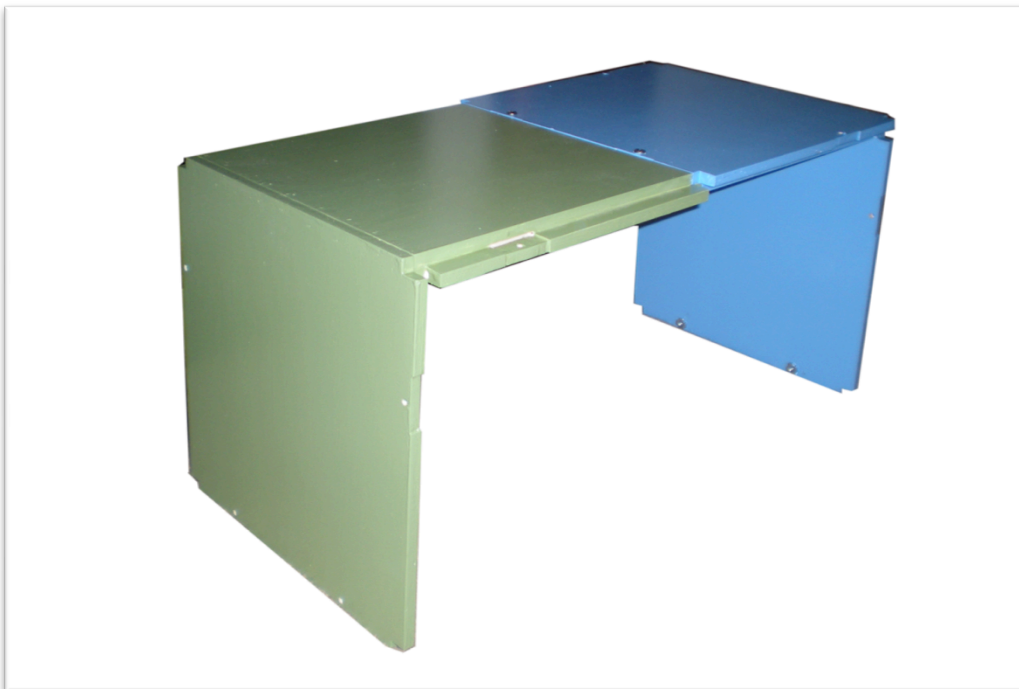
After a slab was glued and dried, the designer sanded the exterior surface to create a smooth texture, similar to a plastic. Then, it was time to assemble the right angles. Glue was applied to the ends of the slabs and positioned in place. The designer used finishing nails to hold the pieces in place while the glue dried. The nails also serve as extra reinforcement. When the glue was dried, the right angle became a very sturdy piece. The glue held well, and it was as if the product was made from a single piece. It did not wobble like the previous test models.

The next steps were finishing the surface. To make it easier to paint the edges, the designer put a thin layer of wood glue on all of the edges of the wood. This was to prevent the wood from soaking up the paint. When that glue was dry, the designer used a foam roller to apply white primer paint to all surfaces of the wood. When that was dried,

the designer applied two coats of the final glossy latex paint. The designer chose a glossy paint to resemble a plastic material. With this, the wood construction was complete. All that was needed was the metal hardware.

The most important metal hardware is the metal connector. This piece could not be bought as-is in the store. The designer purchased a thin strip of metal at the desired width and depth of the connector. Using the tools in the metal shop, the designer was able to cut the strip into pieces of the correct length and drill a hole in the center of each.

The other hardware could be bought premade. To hold the connectors in place, the designer used round-headed bolts and T-nuts. The T nuts were hammered into the holes of the underlay side of each angle. They will stay fixed in place, and the bolts can be screwed into them without hanging out of the hole. When put together, most of the metal hardware cannot be seen, and the connection is almost hidden.



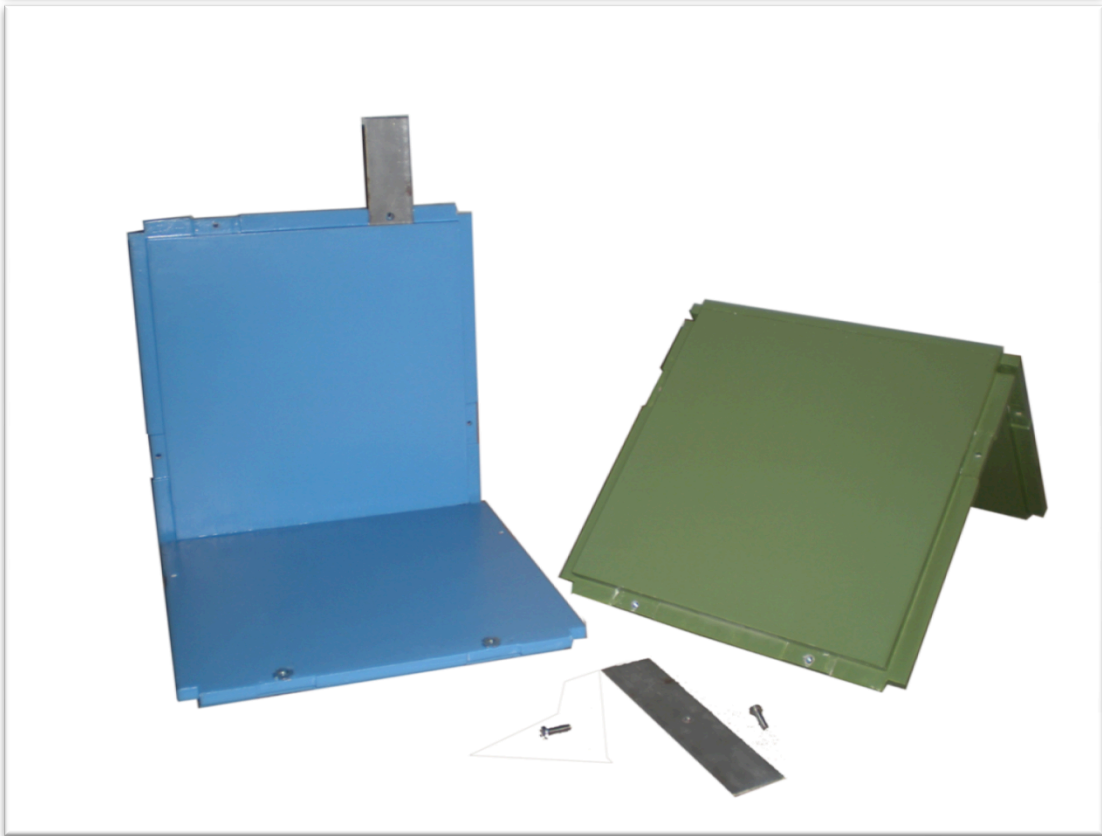


Figure 58: Photo 5, Prototype

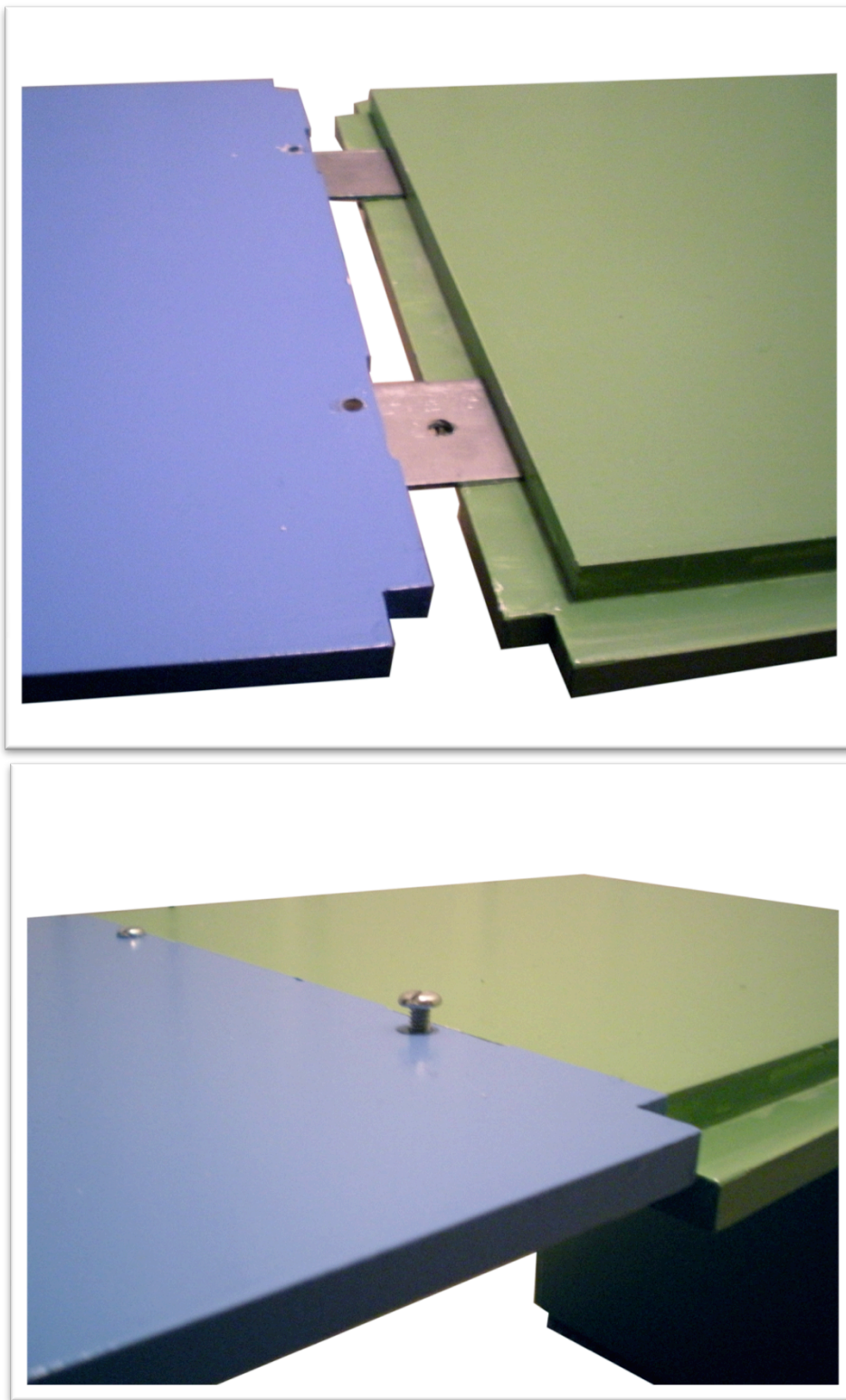


Figure 59: Photo 6, Prototype Details

Phase 7: Further Development

At this point in the design process, the designer has created the necessary components of the “Right Angles” furniture pieces. The designer has tested the strength of the design with some modifications in material and construction methods, and the designer has built full scales models both digitally and physically. A lot can be learned from these models, and this can lead to further development. While many of the details to the design have been developed, there are still a few details that can be further explored.

One major step in continuing the development of the design would be to consult an engineer. Due to the limited facilities available to the designer, the design could not be built affordably in the intended material. Therefore, accurate stress testing could not be executed on a prototype. By consulting a professional, the designer could learn if the design would be strong enough if built in plastic. Plastic is ideal for this design for several reasons. Plastic can be molded into very detailed forms, such as that of the “Right Angles,” and it can be constructed of one single piece. The material is also strong and rigid, and most of all, it can be composed of many colors and still be translucent. The translucency allows the interior structure to be revealed, thus creating detail and showing the complexity of the design.

A specialist could also propose the best method for molding the plastic and suggest the best plastic to use for this design. There are a wide variety of plastics, with many different properties. A strong sturdy plastic is needed for this design, but the plastic must also resist cracking. One possible plastic to use is reinforced clear polypropylene. This polypropylene is a strong, rigid, lightweight plastic with characteristics such as cost

effectiveness and weather resistance. This plastic can also be transparent, translucent, or opaque, and provides a wide range in color options for the user. It is also recyclable, which is appealing to the Millennial generation. (Lefteri)

Along with the material, a specialist can help engineer a mold for the plastic. There are several tricky areas in the design. For example, the thin slots running parallel with the surface may be difficult to mold. An engineer would know how to best mold the plastic to come out with the desired results. If there are any issues with molding the design, the engineer and designer can work together to find a suitable compromise.

Some other changes to the design may also be needed. Due to an uncertainty in material, certain areas of the design are questionable in its durability. One area to look at is the hole at the connection point. The bolt hole is very close to the edge of the right angle. With stress placed at this point, it is possible that the plastic material may fracture at this hole. Another area that will need to withhold stress is at the angle. It will help that the plastic version of the “Right Angles” will be made of one single piece and not need to connect two slabs at the angle, but it is unsure if the plastic will need any reinforcement. Proper testing must be done to address these issues.

If tests prove that these areas are too weak, some reinforcement will be needed. The “Right Angles” will be produced by injection-molded plastic. Before the plastic is injected, metal can be placed into the mold. The plastic can be injected around the metal, encasing it inside the piece. This metal would provide more strength to that area. Metal angles can be imbedded into the plastic. In order to maintain a uniform appearance, the

metal angles can match the metal connection pieces. The angles will be seen through the translucent plastic, so they should line up with the connection points across from them.

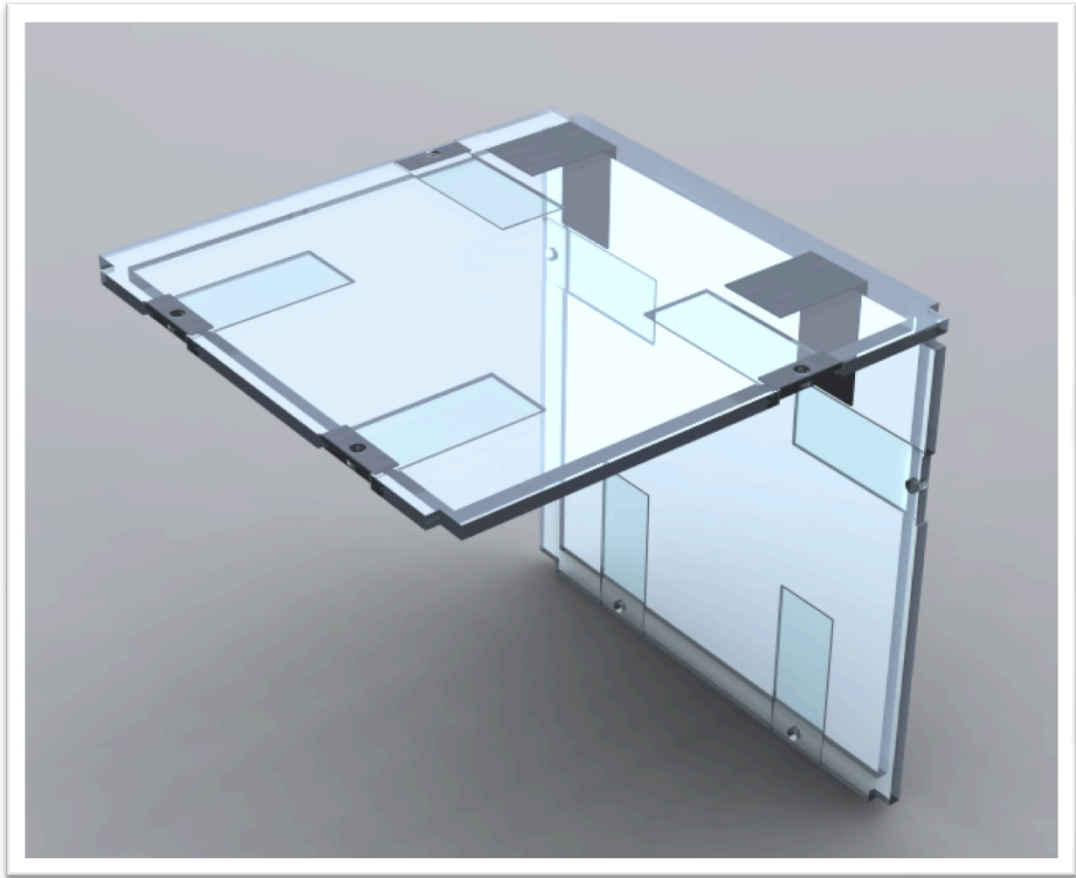


Figure 60: Render 20, Reinforced Plastic Right Angle

The added metal supports can be seen as a design's opportunity and also adds to the aesthetic quality of the design. There is a contrast between the metal and voids within the plastic. With both of these characteristics remaining visible, the functionality of the design can really be seen. By adding connector pieces, the voids will be filled and the piece will take on a new look.

Besides material and strength testing, there are some other areas that can be explored further. One detail that can be improved upon is the edging of the “Right Angles.” If all of the edges are molded to be perfect 90-degree angles and come to a point, this may be too sharp for the user. It might hurt someone’s legs when they sit on it. Also, when two pieces are joined, the crack may pinch someone. A softer edge is needed to solve these issues. The designer has proposed this soft round-over edge and a slight concave curve to the inner angles of the piece. No angles will go to a sharp point.

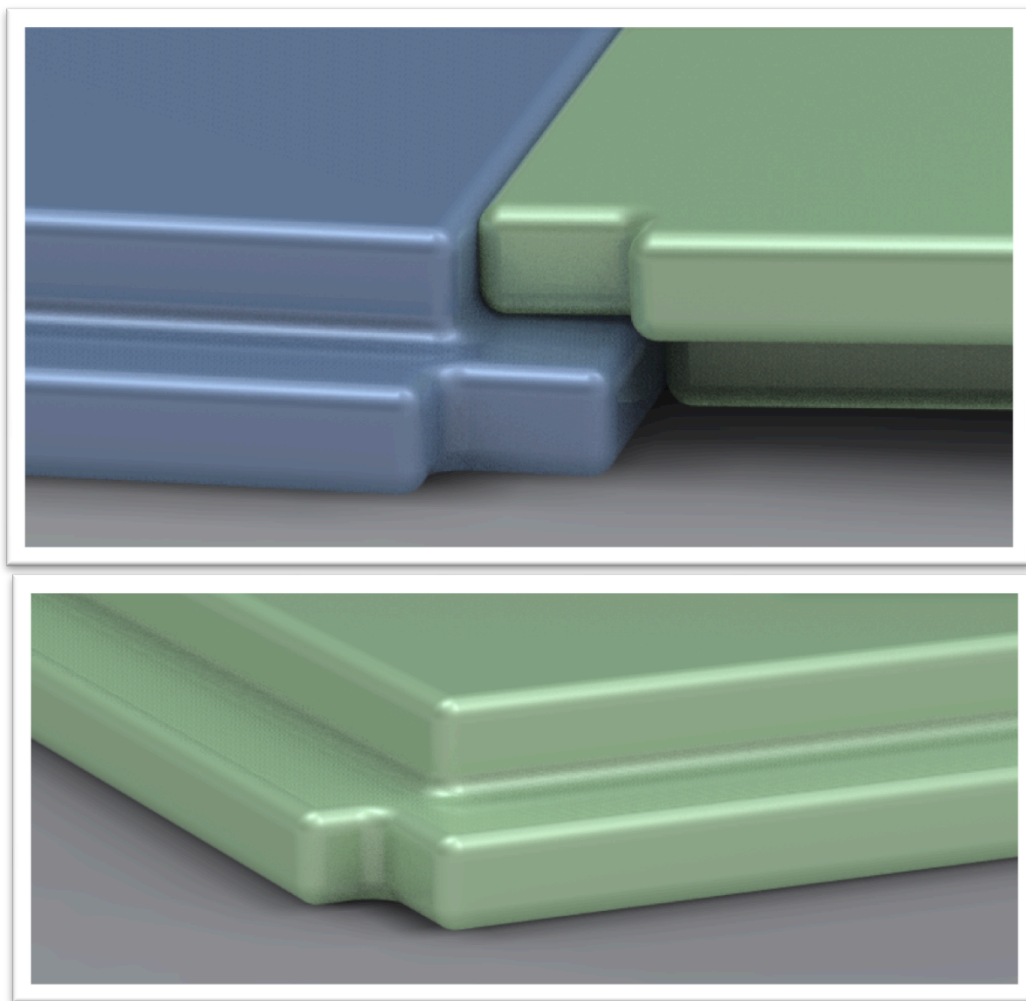


Figure 61: Render 21, Rounded Corners on Right Angle Design

Another area to look deeper at is the texture of the “Right Angles.” While plastic can work well with a smooth flat surface, molds can also be made to create a texture to the surface. A texture can help make a surface less slippery, reduce the translucency, or provide another option in personalizing the product. The texture pattern will be another option for the consumer to choose when purchasing the product.

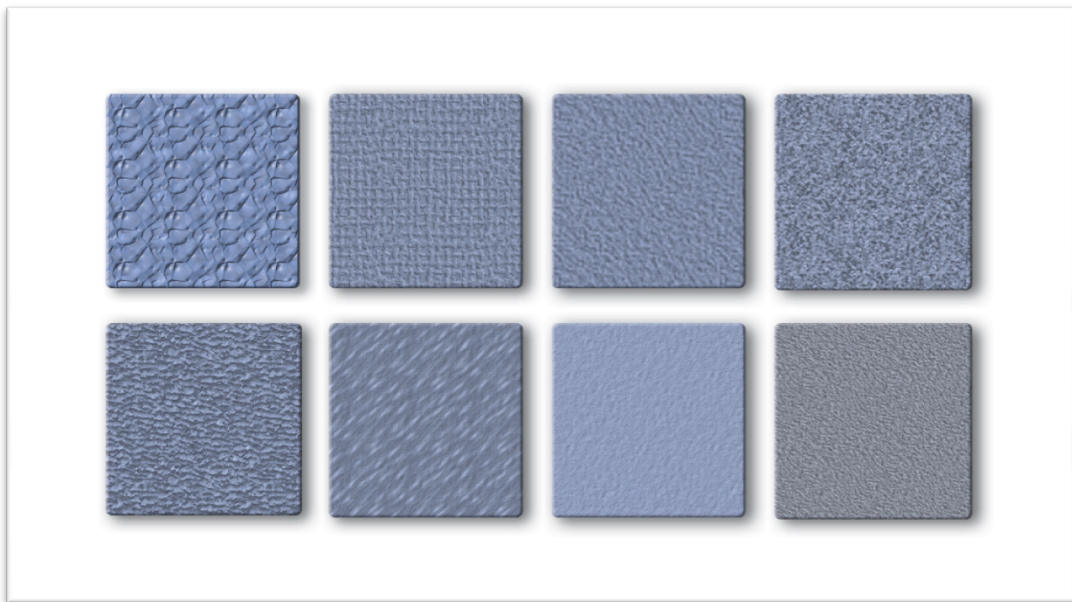


Figure 62: Texture Samples

Along with texture, the consumer will also be able to select the color of each “Right Angle.” A selection of colors will be offered for the consumer to choose from and create their own color combinations. Standard, bright, and light color palettes will be available, as well as a limited edition of the season’s color trend. By dividing the colors into these categories, it will help eliminate the overwhelming feeling of too much option. However, this variety of colors will still provide a range of customization possibilities.

All of the colors will be about translucent in order to see the connection details within the plastic. To decrease the translucency, the consumer can choose to incorporate a texture to the surface.

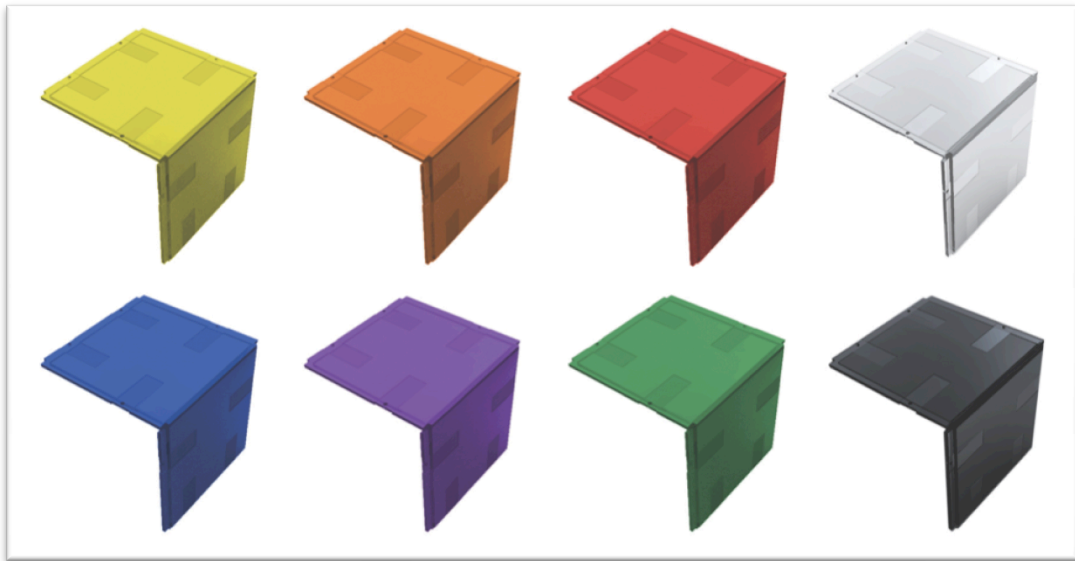


Figure 63: Standard Colors Samples



Figure 64: Bright Colors Samples



Figure 65: Light Colors Samples



Figure 66: Current Colors Samples

Color is important when designing for Millennials. The Millennial generation is open to new and more diverse products. Millennials also have a desire to express their individuality. This desire has inspired more colorful and exciting products, such as colorful cell phone covers and colored laptops. This generation craves choices and a visually appealing product. These color selections were chosen to cover a wide range of options for the consumer, but also create a more playful feel for the product. A rainbow of color makes the product more exciting and inviting to interact with. The Standard, Bright and Light color palettes provide the user with a range of typical colors that could be used in the space, and the Current color palette gives the user the ability to keep in trend with color. Millennials like to express themselves, but many also like to follow a trend. The Current colors displayed here are colors inspired by the current 2010 trends found in contemporary products at the IHFC of the High Point Furniture Market.

CHAPTER V

CONCLUSION

This designer has studied various 20th and 21st century precedents of multifunctional, interactive furniture, and has incorporated these methods into the designs explored throughout the design process. Matali Crasset's designs, such as Digitspace or Poofs, (See page 21) use objects of a single simple shape to create various furniture types when these shapes are placed together in different ways. These objects can also shape the space, thus allowing the users to personalize their environment. This technique is seen in many of this designer's ideas throughout the design process, resulting in a final product that is also interactive and multifunctional.

This designer designed furniture to be not only interactive and multifunctional, but also suitable for a small space. Several precedents show how furniture can accommodate a small space. Among these precedents are Table Trays and Shelves by Matali Crasset. (See page 24) With this design, trays can be stored on the wall or used on the table. This allows the table to become a place for many activities. Providing storage and providing multiple uses is of vital importance when dealing with small spaces. Sarah Susanka also shares this method of saving space. By creating multiple use spaces, maximizing storage, and dividing a larger space into sections, a small space can seem larger. (See page 5)

This designer used these methods throughout the design process. The designer's "Right Angles" design, because of its flexibility and ability to change function, has the ability multiply the usage of a small space. The "Right Angles" also stack upon each other to save space when not in use. They can even help to create smaller spaces within a space by forming room dividers of many shapes and sizes.

Another space-saving trend in today's culture is making products smaller and thinner. Making the product thin and occupy less space was a driving concept of the design process. Like the laptop computer or the plasma TV, the right angles are made up of thin lines and do not take up much space. Also, with the translucent plastic, the "Right Angles" appear to have even less mass. The plastic material is also lightweight and easy to move around.

Not only are the material and light appearance accommodating to a small space, but also the shape of the "Right Angles" contributes to its ability to conform to a small space. Small spaces can be hard to furnish with traditional furniture. Traditional furniture is often large and only serves one purpose. This limits the activities that can take place in the space. With such an array of configurations, the "Right Angles" can provide the user with many furniture options and can also work well in any type of small space. Small spaces come in many shapes and sizes, but most likely, they will contain walls that meet at a 90-degree angle. The orthogonal shape of the "Right Angles" allows for them to blend with the space by echoing the preexisting angles. The pieces can easily be stored by stacking them in a corner, or they can be utilized within any type of space.

Along with creating products that save space and serve multiple functions, this designer targets a specific generation, the millennial generation. Millennials typically like to live in exciting urban settings and often live in smaller living spaces. Millennials can have a strong desire to express themselves and make an impact. There is more of a desire for interactive furniture that the user can personalize and make his or her own.

Lisa Johnson, author of “Mind Your X’s and Y’s,” describes ten cravings of this generation’s consumers. While not all cravings apply to furniture, this designer has picked four important cravings that will help in designing furniture for the Millennial generation. “Shine the Spotlight” is the craving for personal recognition and the power of personalization. The designer’s ideas throughout the design process have been based on this idea of personalization. With the “Right Angles” design, the user can choose the colors, textures, and sizes of the pieces they purchase. They can also rearrange the “Right Angles” into different forms, and by creating configurations, they can personalize their space to suit their mood and personality. Users can express themselves through the product.

“Give Me Brand Candy” is the craving for better design. People want to buy things that look good and are appealing to all the senses. With a wide range of color and texture options, users will find a color and texture that appeals to them. Also, this furniture is different from what is out in the marketplace. Millennials want products that are different and interesting that they can make their own. Products now have to include the entire experience and not just an isolated product. The “Right Angles” design

includes an experience starting with the purchase and extending through the interactive use of the product.

“Raise My Pulse” is the craving of more exciting, interactive, and compelling experiences, and “Build it Together” is the craving to participate in some way.

Millennials want a hands-on experience, so these cravings were also in mind throughout the design process. The designer incorporated user-interaction and flexibility in the design. The user can maneuver the “Right Angle” pieces into a variety of configurations to form his or her own space. The user chooses what to create and has the ability to build it and change it.

This designer uses techniques used by other avant-garde designers and knowledge of a specific user group, all while designing for small spaces. Not only does the final product satisfy the cravings of the Millennial generation, but the “Right Angles” design also enhances and maximizes a small living space.

REFERENCES

Environment and Social Behavior

Altman, I. (1975). *The environment and social behavior: privacy, personal space, territory, crowding*. Monterey, CA: Brooks/Cole Publishing Company.

Ashcraft, N. & Schefflen, A. E. (1976). *People space: the making and breaking of human boudaries*. Garden City, NY: Anchor Press.

Gregory, D. & Urry, J. (Eds.). (1985). *Social relations and spatial structures*. New York: St. Martin's Press.

Whyte, W. H. (1980). *The social life of small urban spaces*. Washington, D.C.: The Conservation Foundation.

Crowding

Aiello, J. R. & Baum, A. (Eds.). (1979). *Residential crowding and design*. New York: Plenum Press.

Gurkaynak, M. R. & LeCompte, W. A. (Eds.). (1979). *Human concequences of crowding*. New York: Plenum Press.

Insel, P. M. & Lindgren, H. C. (1978). *Too close for comfort: the psychology of crowding*. Englewood Cliffs, NJ: Prentice-hall, Inc.

Furniture and Space

Miel, R. (2007). Firm turns to plastics for chair. *Plastics News*, 42.

Wadler, J. (2007, November 1). And now from Germany, a bed by remote control. *The New York Times*.

Housing Economy

Celock, J. (2008). *Young professionals embrace buyer's market*. Retrieved April 23, 2009 from <http://www.frontdoor.com/Buy/Young-Professionals-Embrace-Buyers-Market/852>

Koch, W. (2009). *New homes being built smaller*. Retrieved March 11, 2009 from http://www.usatoday.com/money/economy/housing/2009-01-08-homesize_N.htm

The Associated Press. (2007). *Why you can't afford a home*. Retrieved March 11, 2009 from <http://articles.moneycentral.msn.com/Banking/HomeFinancing/WhyYouCantAffordAHome.aspx>

Methodology

Gray, C. & Malins, J. (2004). *Visualizing research: A guide to the research process in art and design*. Ashgate.

Millennials

Broido, E. (2004). Understanding diversity in millennial students. *New Directions for Student Services*, 106, 73-85.

Debard, R. (2004). Millennials coming to college. *New Directions for Student Services*, 106, 33-45.

Generation Y: The Millennials. (2006). *NAS Insights*. Retrieved November 24, 2008 from www.nasrecruitment.com/talenttips/NASinsights/GenerationY.pdf

- Howe, N. & Strauss, W. (2000). *Millennials rising*. New York: Vintage Books.
- Johnson, L. (2006). Mind your x's and y's: Satisfying the 10 cravings of a new generation of consumers. New York: Free Press.
- Kersten, K. (2007, May). Guess what troubles young people the most? *New America Media*. Retrieved November 24, 2008 from http://news.newamericamedia.org/news/view_article.html?article_id=4ed66f801849d9886ea85415b435bf1b
- Lancaster, L. & Stillman, D. (2002). *When generations collide*. New York: HarperCollins Publishers Inc.
- Miles, S. (2000). *Youth lifestyles in a changing world*. Philadelphia: Open University Press.
- Nayak, A. (2003). *Race, place and globalization: Youth cultures in a changing world*. New York: Berg.
- Nayak, A. & Kehily, M. J. (2008). *Gender, youth and culture: Young masculinities and femininities*. New York: Palgrave Macmillan.
- Oblinger, D. (2003). Boomers, gen-Xers, & millennials: Understanding the new students. *Gender, youth and culture: Young masculinities and femininities. Educause Review*, 36-47.
- Olsen, S. (2005, November 18). The 'millennials' usher in a new era. *CNET News.com*, Retrieved November 24, 2008, from http://news.cnet.com/2009-1025_3-5944666.html

The future of helicopter parents. (2007, September). *PR Web*. Retrieved November 24, 2008 from <http://www.prweb.com/releases/2007/09/prweb555471.htm>

The New Strategist Editors. (2001). *The millennials: Americans under age 25 (1st Ed.)*. Ithaca: New Strategist Publications, Inc.

The New Strategist Editors. (2004). *The millennials: Americans born 1977 to 1994 (2nd Ed.)*. Ithaca: New Strategist Publications, Inc.

Modern Architecture

Lane, B. M. (Ed.). (2007). *Housing and dwelling: Perspectives on modern domestic architecture*. New York: Routledge.

Tsuzuki, K. (1999). *Tokyo: A certain style*. San Francisco: Chronicle Books.

Plastic

Lefteri, C. (2006). *Plastics 2*. Switzerland: Roto Vision SA.

Precedents

A Discussion with French Designer Matali Crasset. (2006). Retrieved May 7, 2009 from <http://www.artinfo.com/news/story/18928/a-discussion-with-french-designer-matali-crasset/>

Japanese compact kitchen nobody- futuristic kitchen island from Toyo. (2008). Retrieved from <http://www.trendir.com/archives/002616.html>

Unplggd Asia: Living inside furniture. Retrieved February 23, 2009 from <http://www.unplggd.com/unplggd/home-office/unplggd-asia-living-inside-furniture-057249>

<http://www.matalicrasset.com/>

<http://www.hi-hotel.net/uk/index.php>

Small Spaces

Abdelnour, C. B. (2000). *Big ideas for small spaces*. Gloucester, MA: Rockport Publishers, Inc.

About studio apartments. Retrieved April 23, 2009 from

http://www.ehow.com/about_4567932_studio-apartments.html

Ball, R. (1989). *Making space: design for compact living*. New York: The Overlook Press.

Brun, C. (2009). *New era of smaller living dawns*. Retrieved February 27, 2009 from

<http://www.courier->

[journal.com/article/20090221/FEATURES08/902210306/1041/FEATURES](http://www.courier-journal.com/article/20090221/FEATURES08/902210306/1041/FEATURES)

Hart, K. *Small is beautiful*. Retrieved February 20, 2009 from

<http://www.greenhomebuilding.com/articles/small.htm>

Lam, A. (2007). *Living the American dream ... in a one bedroom apartment*. Retrieved

February 23, 2009 from <http://www.alternet.org/story/47708/>

Learning to live small: Dealing with downsizing. Retrieved February 20, 2009 from

<http://www.apartmenttherapy.com/chicago/inspiration/learning-to-live-small-dealing-with-downsizing-074213>

Parikh, A. (1994). *Making the most of small spaces*. New York: Rizzoli International Publications, Inc.

Pressman, A. & Pressman, P. (1980). *Integrated space systems, vocabulary for room language*. New York: Litton Educational Publishing, Inc.

Rozhon, T. (1997). *The market strengths for small apartments*. Retrieved February 27, 2009 from <http://www.nytimes.com/1997/04/06/realestate/the-market-strengthens-for-small-apartments.html?sec=&spon=&pagewanted=all>

Small house society. Retrieved from <http://www.resourcesforlife.com/small-house-society>

Small house style. (2007). Retrieved from <http://www.smallhousestyle.com/>

Small houses have big appeal. (2009). Retrieved March 11, 2009 from <http://www.argusleader.com/article/20090301/LIFE/903010311/1004/life>

Susanka, S. (2001). *The not so big house*. Newtown: The Taunton Press.

Susanka Studios. (1998-2009). *The not so big house website*. Retrieved from <http://www.otsobighouse.com/>

Woodard, J. (2008). *Today's growing trend: smaller homes*. Retrieved February 27, 2009 from <http://www.creators.com/lifestylefeatures/open-house/today-s-growing-trend-smaller-homes.html>

Downsizing

Crane, A. (2008). *Downsizing: Making do with less*. Retrieved February 27, 2009 from http://www.bankrate.com/brm/news/moving_on/2004_guide/downsizing-home.asp

Tully, S. (2008). *Downsizing the American hone*. Retrieved February 27, 2009 from
http://money.cnn.com/2008/06/02/real_estate/Downsizing_American_Home_Tully.fortune/index.htm?postversion=2008060407

Umberger, M. (2009). *Downsizing trend already in full swing, realty pro says*. Retrieved February 23, 2009 from
<http://archives.chicagotribune.com/2009/jan/11/realestate/chi-umberger-small-part2-0111jan11>

Woolsey, M. (2008). *America's luxury homes, downsized*. Retrieved February 27, 2009 from http://www.forbes.com/2008/10/13/homes-small-luxury-forbeslife-cx_mw_1013realestate.html

Japanese

Egenter, N. *The Japanese house*. Retrieved May 7, 2009 from
<http://home.worldcom.ch/negenter/410JapHouseTxEl.html>

Smith, C. (2004). *Living small: Grace-filled notes from apartments in Japan*. Retrieved May 7, 2009 from <http://www.sfgate.com/cgi-bin/article.cgi?file=/chronicle/archive/2004/11/20/HOGGU9T1RS1.DTL>

Appendix A

A Previous Study

Optimizing College Life Within Constrained Space

A place for self-awareness and identity, creativity and exploration, and privacy and social interaction are necessary for healthy student development. The dorm room is a place where all of these things need to happen. A report from Educational Facilities Laboratories states, “Now, college is the place where the young go to seek and experiment with their own identity, their own culture. Dormitories can provide a stage for these experiments.” (EFL)

For many students, going to college is a major turning point in their lives. The typical college freshman will be leaving home for the first time to enter a new world of independence and change. This stage is a time between adolescence and early adulthood. While the student now has the ability to make choices for himself and live separately from parents, there is still a need for parental support. The student needs a balance of structure and the freedom to shape his or her identity. (DeCoster)

With this new sense of independence, students have a desire to control their environment and have the ability to choose where and how they live. A major reason why students move off campus into their own apartments is because they have a variety of living options and can choose where they live. Another reason is a desire for one’s privacy and ability to control their environment without rules and regulations. Students have a need to manage their environment and retain their privacy as an individual. (EFL)

Based on a 1973 report by the U.S. Department of Health, Education, and Welfare, personal privacy is essential to our well-being; physically, psychologically, socially, and morally. Others such as Paul Freund and Michael Weinstein say that privacy

is vital to self-development. Privacy allows for self-awareness, self-direction, innovation, and the ability to feel unique. Privacy gives people the ability to create, explore, and experiment. (Solove) While privacy is a need for all people, needs such as self-development and creativity are essential to emerging college students living in dormitories.

Dormitories must also provide students with a humanizing environment. In order for a residence hall to be effective as a humanizing environment, it must have four characteristics that are needed to be human: stimulation, security, freedom, and order. (DeCoster)

When looking at stimulation, a person has two sensory thresholds. If the level of stimuli in an environment falls below the lower threshold, a person will seek stimulation. W. Harold Grant from Auburn University explains, “These stimuli are forms of energy that can activate sensory organs and, we are told, a person deprived of these stimuli for a period of time will deteriorate and eventually die.” In order to function properly, an individual must be in an environment that contains an adequate amount of stimuli. Therefore, dorm rooms must contain an adequate amount and variety of stimuli. (DeCoster)

In contrast, if the level of stimuli were to exceed the upper threshold, it can create stress for the individual, and continuing stress can also lead to unfavorable consequences. People have a need for security and self-protection from unwanted amounts and types of stimuli. This need for security is also known as the need for privacy. Therefore, dorm rooms also need to have a level of privacy that suits the needs of the student. (DeCoster)

Another human need, order, is needed to support cognitive and logical behavior. Unordered environments can cause confusion and frustration. Since dorms are greatly related to the academic environment, cognitive and logical behaviors are essential for an effective dorm space. While order is needed in working environments, freedom is also needed to spur creativity and innovation. Therefore, a total balance of stimulation, security, freedom, and order is needed to form the most diverse and livable space for a college student. (DeCoster)

After studying theories on student development, the designer used this knowledge to design dorm room furniture that supports these theories and aids student development within the dorm room. Along with the theories on student development the ability to choose, and the need for privacy, the designer created a multifunctional product that can combine work, rest, and storage within the dorm room.

As a foundation for this project, the designer worked with people from The Wall Sleeper Systemzzz to help them incorporate their product in the dorm room. The Wall Sleeper Systemzzz is a patent pending design, similar to a Murphy bed, that folds and stores a bed into the vertical position. Using knowledge on dorm life and student development, the designer helped to turn their product into a student-friendly multifunctional bed.

When looking at what is needed to create an ideal space for college students, it seems like a lot to fit into a 12'x15' shared space. Students need a place to sleep, a place to work, and a place to rest and socialize. All of these are components of a college

student's daily life, and all are practiced within the dorm room. Something must be there to distinguish these activities.

Not only does the room need to contain these places, but also it must be able to store all of the belongings of the occupant. Everything the student needs to live is contained in such a small space. Books and school supplies, clothes, shoes, linens, utilities, food, furniture, etc are all crammed into such a small space that is used for a variety of activities.

These criteria are similar to that of the Millennial living in a small apartment. The occupant must work, live and sleep in a small amount of space. The occupant must also store all of his belongings within that space. Therefore, the research from this dormitory project can relate to the design thesis. As a result of this, the design development process of the Millennial's furniture is similar to the development of the dorm furniture.

At the start of the project, the designer began by drawing rough sketches of ideas on how to incorporate the Wall Sleeper Systemzzz bed and mechanism. This was a challenge when working with such a small dormitory space. The designer came up with three types of bed styles: Vertical, Horizontal, and Loft. The designer also wanted to incorporate storage as well as desk space into all three designs. There is also the possibility for the mattress to fold, so the designer explored various ways that the mattress can be a couch when folded with a click-clack system. This folding technique was also explored in the early stages of the design process when designing the Millennial furniture.

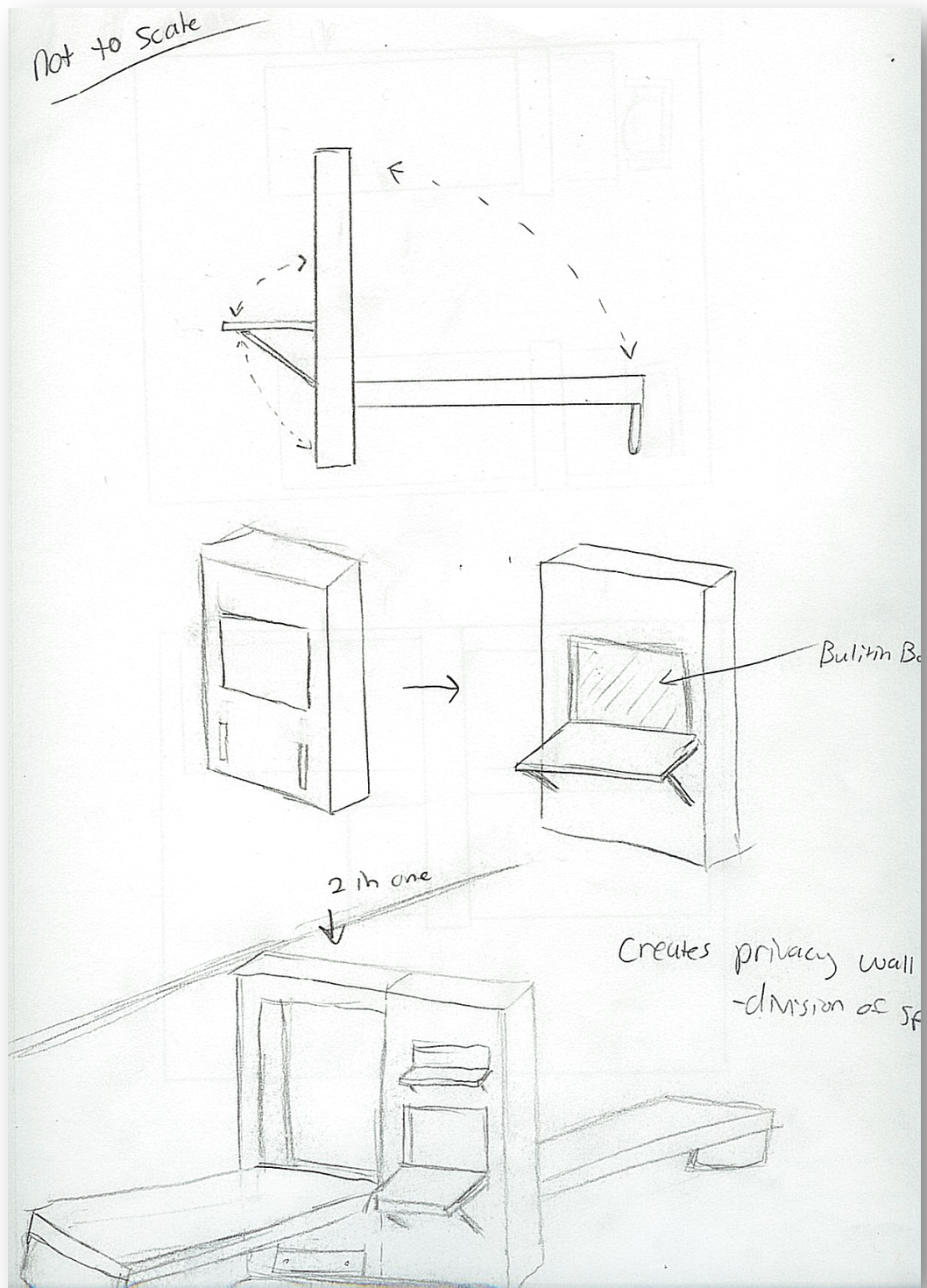


Figure 67: Sketch 1, Vertical Bed

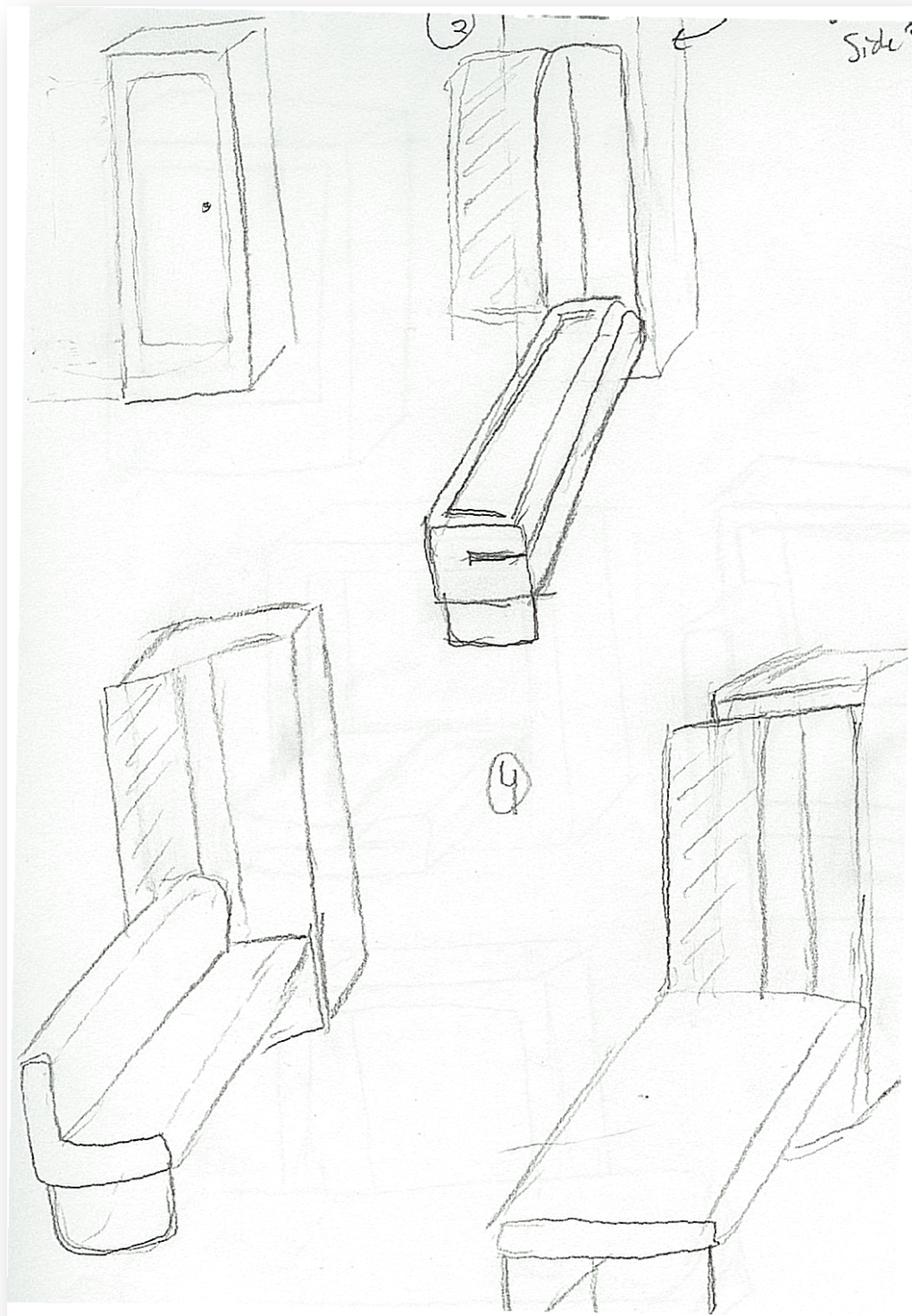


Figure 68: Sketch 2, Vertical Bed Folding

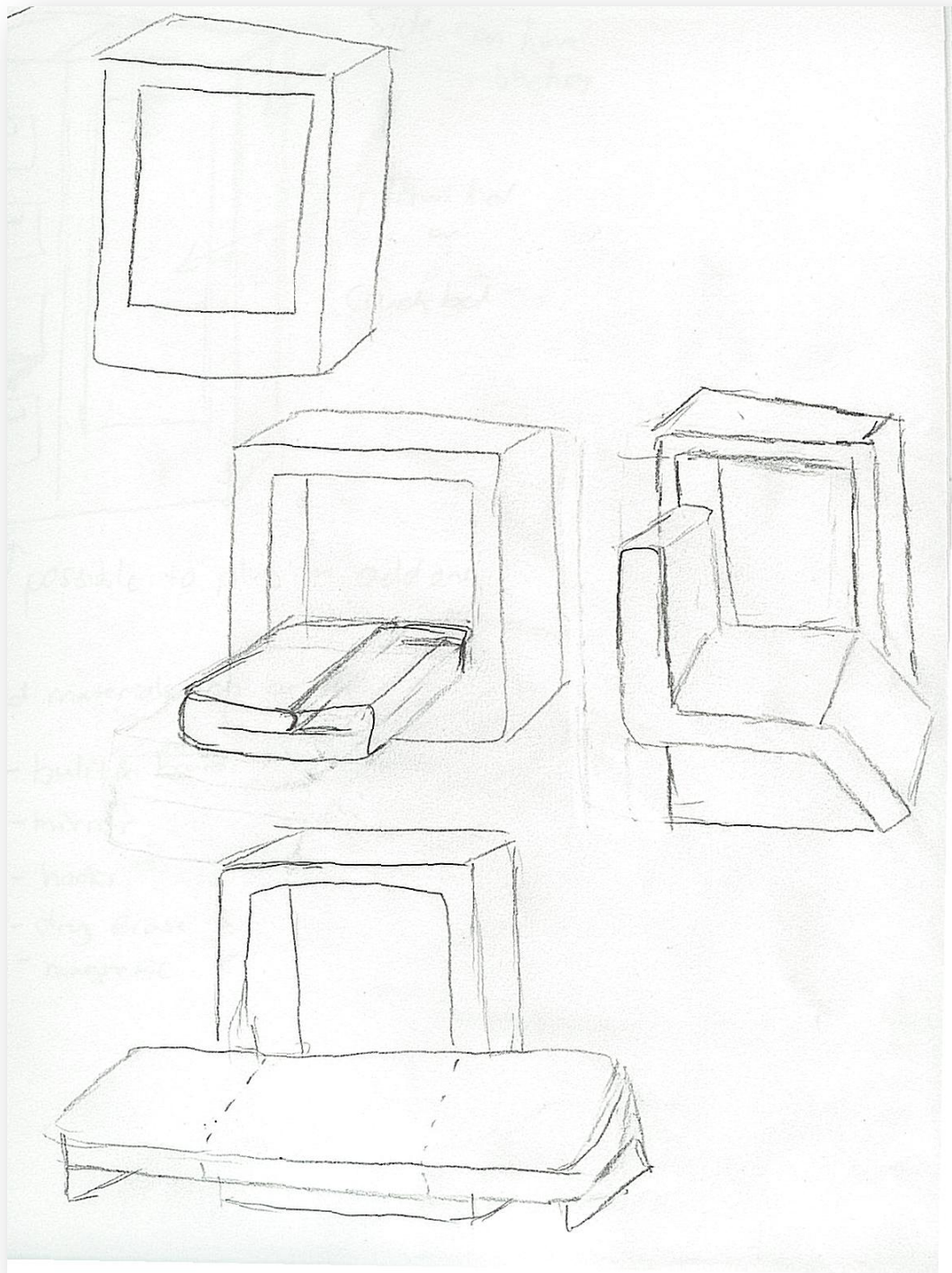


Figure 69: Sketch 3, Horizontal Bed Folding

The idea of making furniture a multifunctional piece was also carried over from the dormitory furniture design process. For example, a chair can contain a place for storage, and it can also be stored and hidden away itself. By designing furniture to have multiple purposes, it not only saves space, but it also alters the traditional typology of that furniture type.



Figure 70: Render 1, Desk and Shelves

The ability to personalize a space was also important in the dorm project. Color and material were used to provide the students with places to personalize the furniture.

Tack boards and magnetic surfaces were some of the materials used to give students a place to attach their own items to make their space more personal.

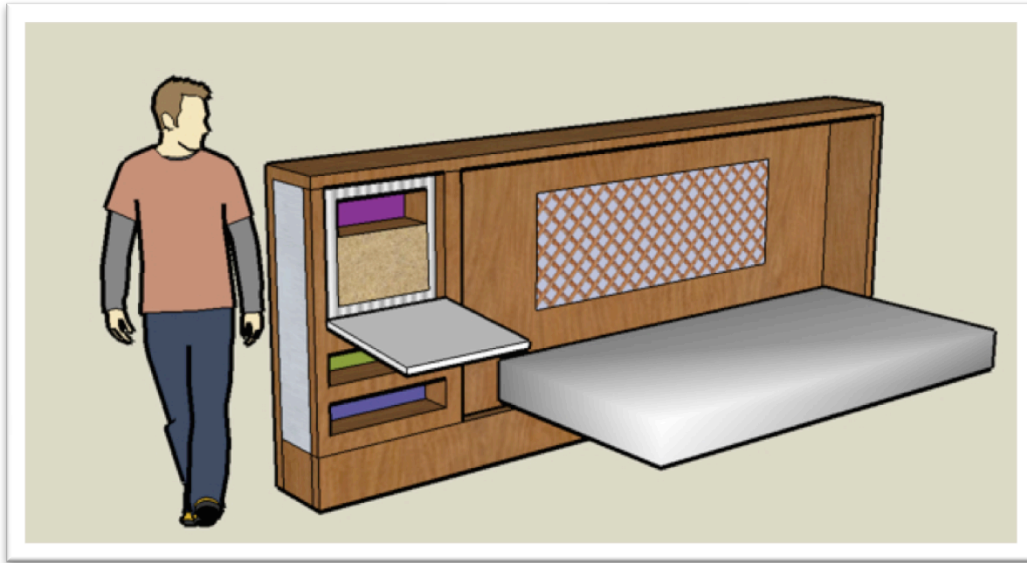
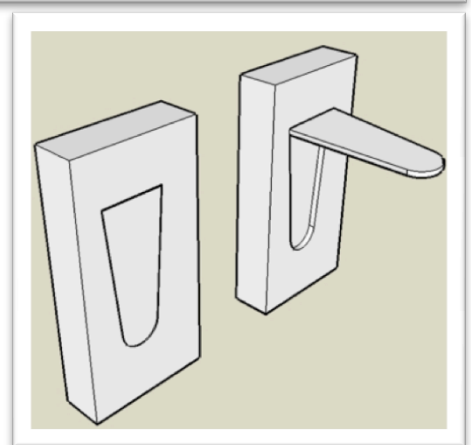
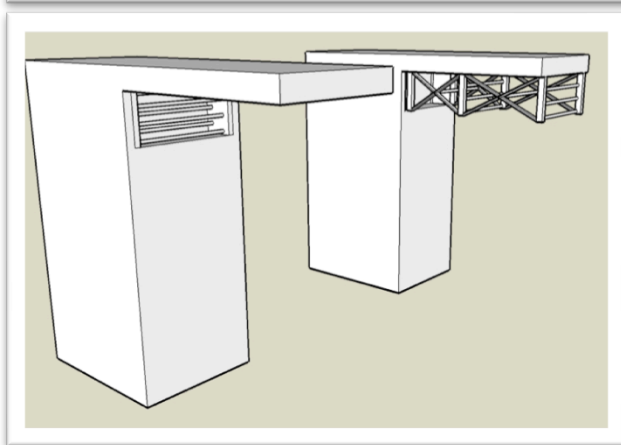
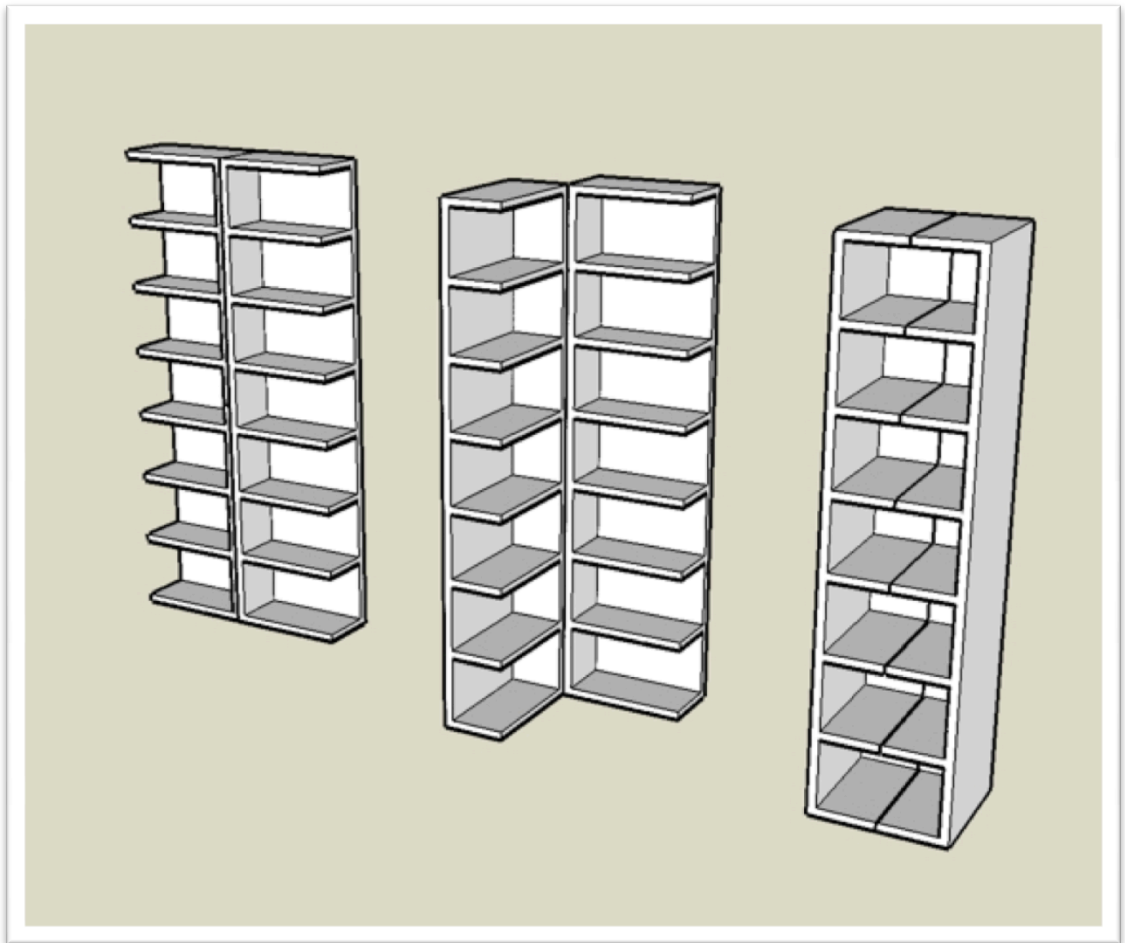


Figure 71: Render 2, Horizontal Bed

Along with designs for the bed and desk, the designer developed various designs for unique storage. Things such as shelves that can fold into cubby space give students an ability to choose their space. The idea to easily transform an object from one form to another was also carried over to designing for the Millennial generation.

The designer also explored ideas for hanging clothes, a drying rack and an ironing board. There was an idea that accessories could be added to the more basic designs of the bed. While adding accessories was not fleshed out in the Millennial furniture design, accessory ideas were considered and would be further developed in future stages.



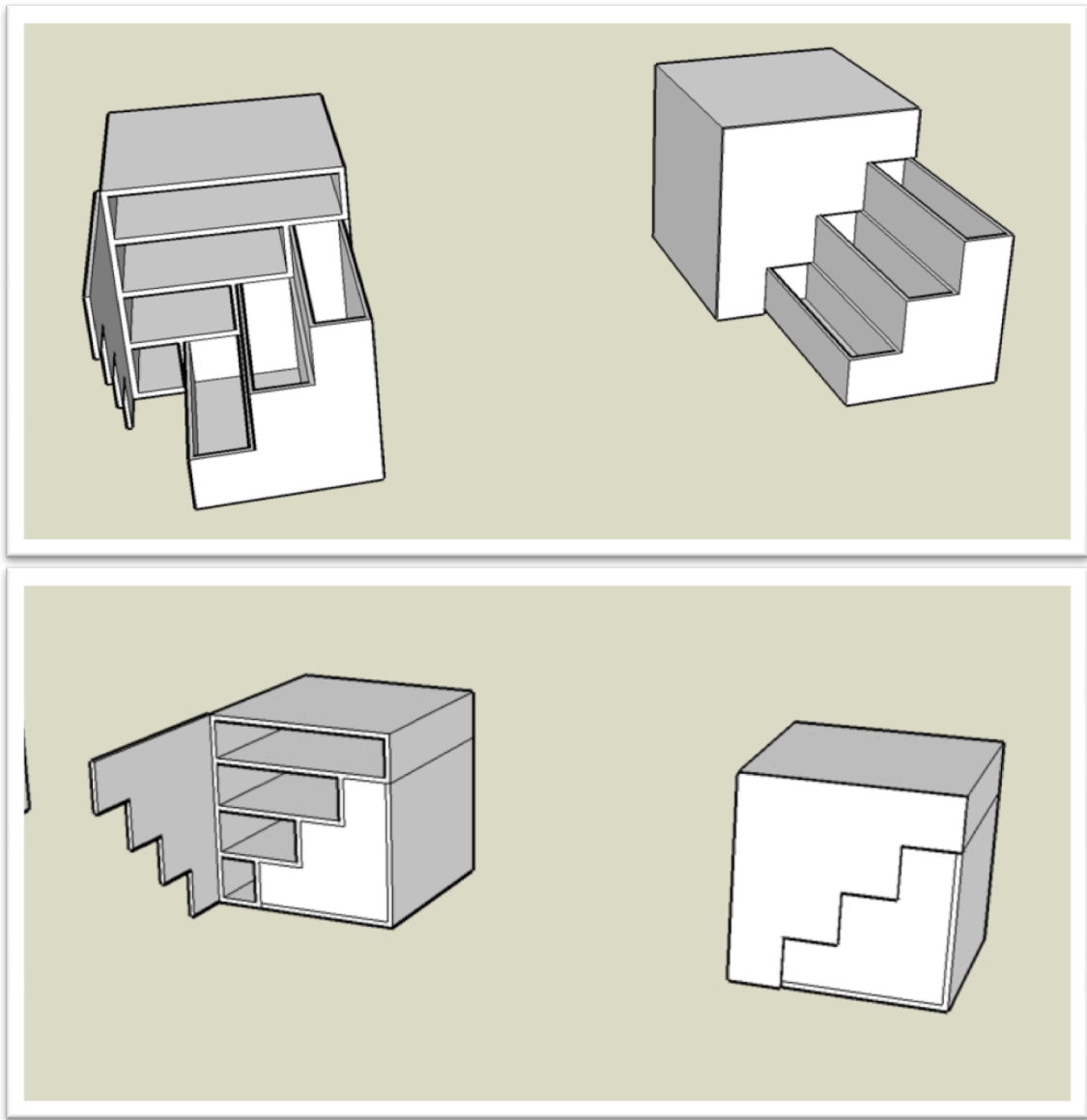


Figure 72: Render 3, Small Parts

At the midterm period, the designer chose to move further with the Vertical bed. This bed fit best within the room and also provided a division of work and rest spaces. There were also several small piece designs incorporated within the bed design. The shelves along the side have the ability to be pulled out at different lengths. Also, there is a

bulletin board behind the desk and tracks for hooks and other accessories.

At the midterm period, a basic form of the product has been developed, but the details have not been worked out. Once the main idea is settled on, it is time to flesh out the specifics and design the overall aesthetics of the product. This same method of design was used in the Millennial furniture design process.

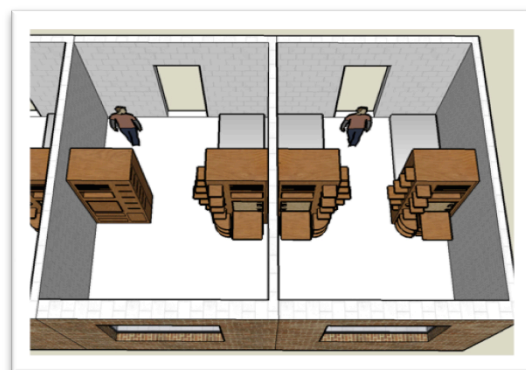
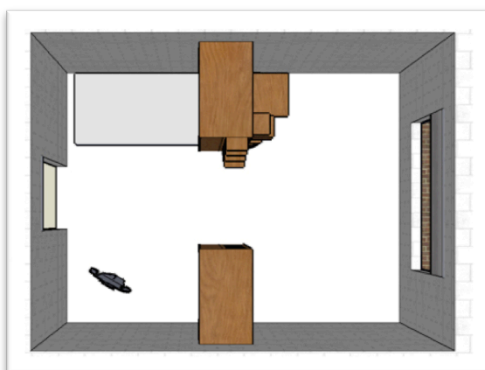




Figure 73: Render 4, Midterm Room Renders

After the basic design was decided on, the construction methods and materials needed to be fleshed out. Due to the need for lower cost products, it was decided that the construction would be of MDF board covered in a faux wood laminate. The edging would be covered in metallic strips that can be used to attach things magnetically to the unit.

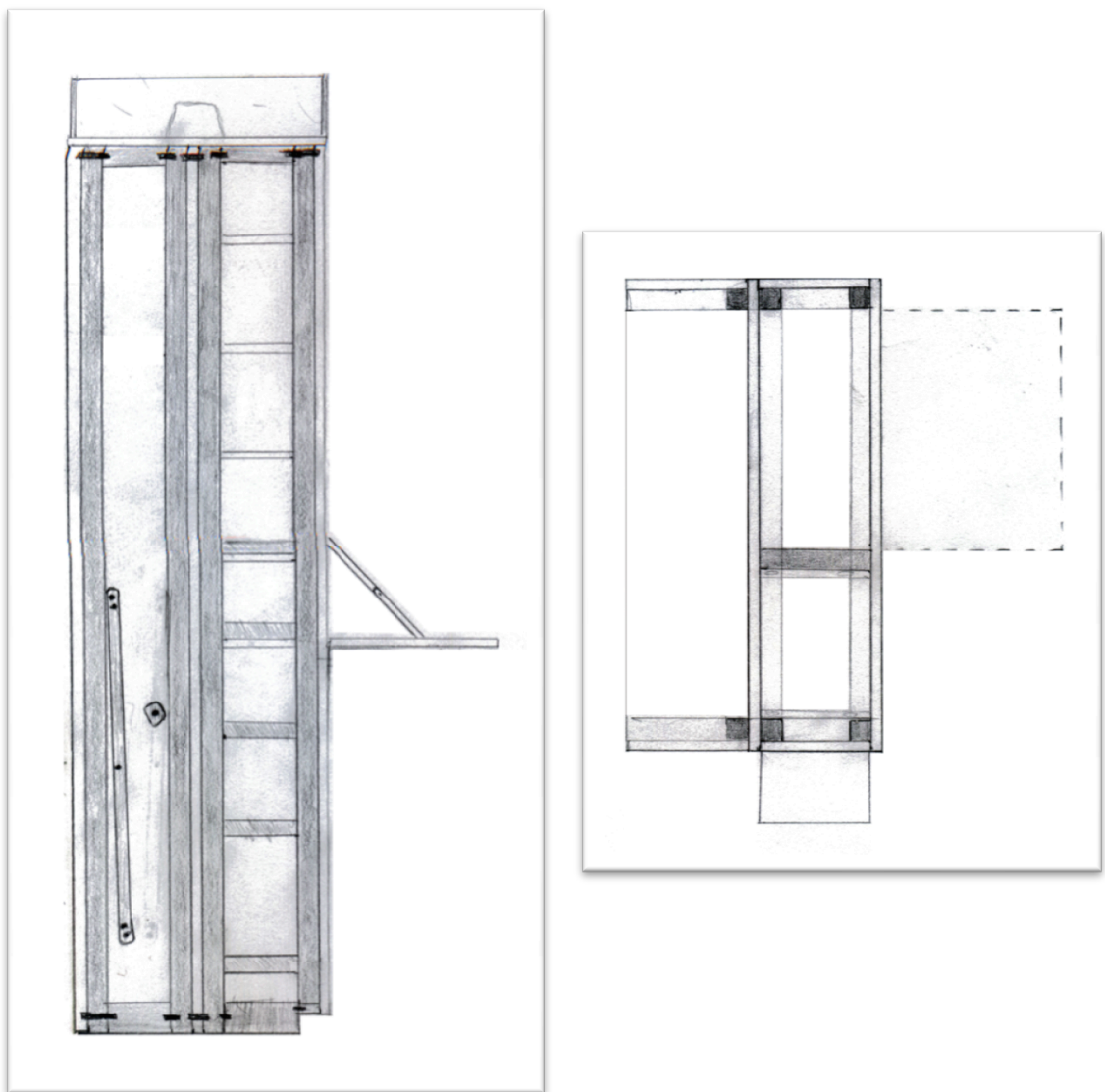


Figure 74: Drawing 1, Section Drawings

For a simpler construct and to provide more volume within the structure for storage, the pull-out shelves were altered to become fold up shelves. When in the lowered position, the shelves became surface areas with various materials. Cork, chalk board, magnetic, and dry erase surfaces would cover the shelf to transform the shelves into tack and writing surfaces to help support creativity and stimulation. They also help the students express themselves and create a more personal space.

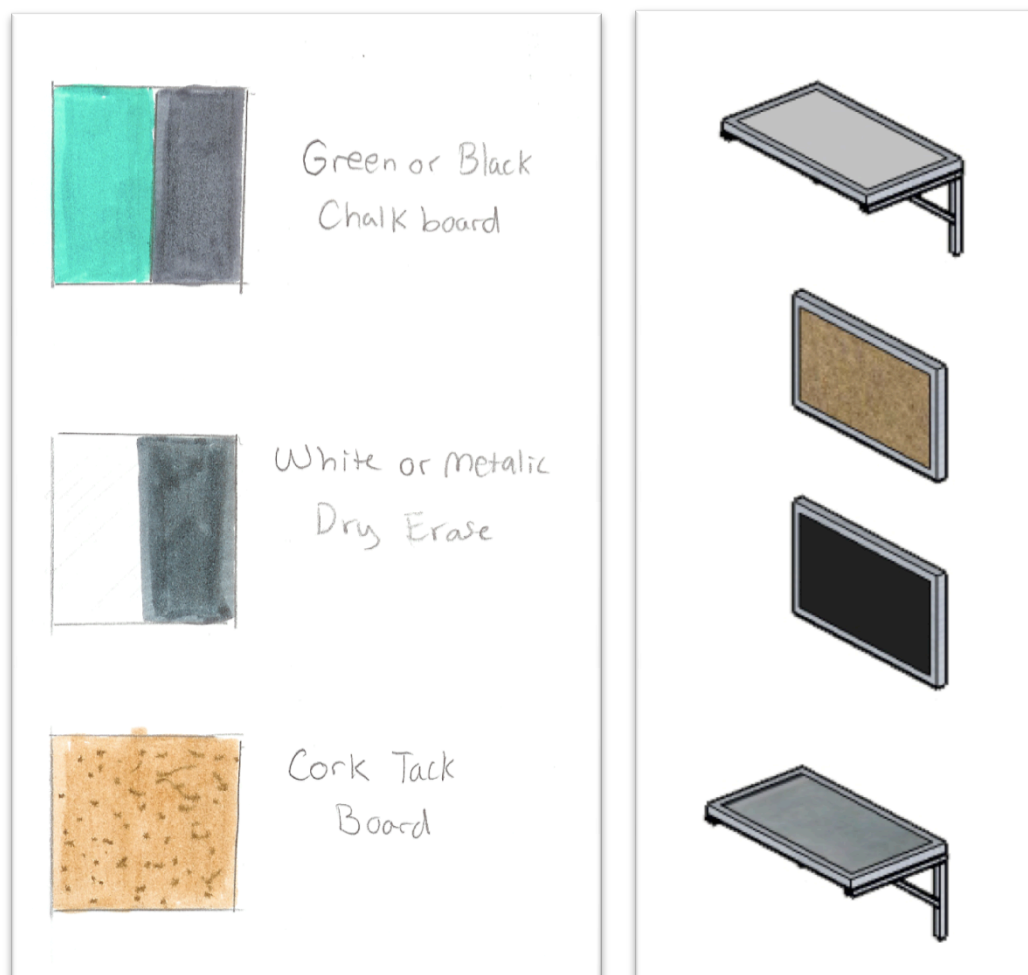


Figure 75: Materials

The final unit contains a bed, desk, dresser, and shelves for storage and display. A tambour door covers the bed when it is in its upright position. Light can be emitted from the window to the bed side when the desk is lowered. The unit is also powered with electrical outlets and lighting both in the desk and on the top. Red, Green, and Blue lights can be turned on separately to form different colors to express the mood of the student.



Figure 76: Render 5, Final Room Renders, Open and Closed Configurations

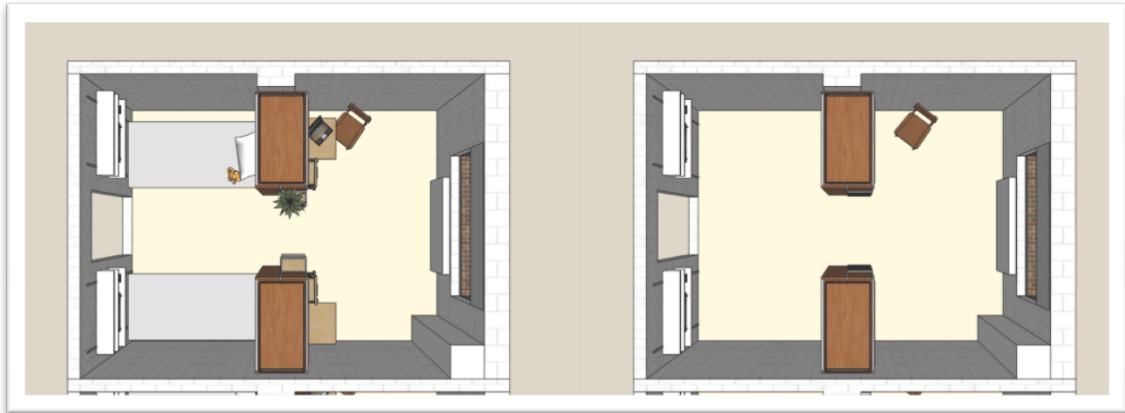


Figure 77: Render 6, Room Configurations



Figure 78: Render 7, Opened Unit in Dorm Room

References

- DeCoster, David A., & Phyllis Mable (Eds.). (1974). Student development and education in college residence halls. Washington D.C.: American College Personnel Association.
- EFL. (1972). Student housing: A report from Educational Facilities Laboratories. New York: EFL.
- Solove, Daniel J. (2008). Understanding privacy. Cambridge: Harvard University Press.

Appendix B

Paper on Wood Joinery and RTA Furniture

Wood Joinery and RTA Furniture Assembly

RTA Furniture

Ready-to-be-assembled (RTA) furniture, also known as flat-pack or knock-down furniture, is furniture that is bought boxed in pieces. The customer provides the last part of the production line by putting the pieces together at home. Many cost savings are made by the customer providing the labor to build the furniture and by the ability for efficiently storing and shipping of the product. Transportation requires simple shifting of stacked boxes of products rather than careful manual handling of assembled furniture. Automated machines can do this. RTA is not only cost effective for the manufacturer, but also convenient for the customer. Many times, they can purchase the product from a store immediately because the retailer requires less space to store the products. Transporting the product home can often be done in the customer's own car.

Gillis Lundgren, who was a Swedish draughts person, invented ready-to-assemble furniture. Lundgren discovered the idea when he could not fit a table into his car. He broke the legs off his table so he could fit it in the car and then reassembled the table at home. Later, he discussed the idea with his employers at IKEA and the company later built its entire business around the concept.

Most companies will pre-drill holes and do other preparation work so that consumers can fit the pieces of the furniture together with minimal work. The furniture is packaged with all of the hardware and tools necessary to assemble it, along with assembly directions. The quality of flat-pack furniture can vary. Some companies use

high quality materials, creating furniture that is meant to last and be attractive. Others use cheaper materials, in response to a demand for low-cost furniture.

Depending on the construction techniques used, flat-pack furniture may or may not break back down easily once it has been assembled. In some cases, the furniture is designed to be taken apart again in the event of a move, while in other instances, more solid connections are used to ensure that the furniture does not break, and these connections make it impossible to take the furniture apart again.

Even though good RTA furniture is solid, it also has its limitations. Because of the way it is put together, RTA furniture does not always move that well. With each move, RTA tends to get weaker, and weak furniture will not last as long. Also, RTA furniture is best if kept clean. As with most any furniture, dust and dirt do not help longevity. Since most RTA is made from Medium-density fiberboard (MDF), this is especially true. RTA is also affected by weather. In dry climates, like in the western US or any desert region, the wood will need to be oiled frequently. Even MDF will have a tendency to crack if it gets too dry.

Wood Joinery

Wood joinery is a part of furniture making that involves joining together pieces of wood. Wood joinery is also used to create structures, toys, and other items. Some wood joints employ fasteners, bindings, or adhesives, while others use only wood elements. Different joinery techniques are used for different requirements. Many traditional wood joinery techniques use the distinctive material properties of wood, and often do not need mechanical fasteners or adhesives. Many Japanese and Chinese traditions include

hundreds of types of joints, many of which do not use glue or nails. Some methods however, do need the assistance of glue or fasteners. Glue is highly effective for joining wood when both surfaces of the joint are edge grain, but glue is ineffective on end-grain surfaces. Fasteners may be as simple as nails and screws, and glue and fasteners can be used together.

A butt joint is created when the end of one piece of wood is simply placed against the adjoining piece, forming a right angle. The two pieces can be fastened with screws, glued or dry dowels, or sometimes staples. RTA hardware consisting of a screw and a barrel nut is another method of securing a butt joint. This joint is also called a Lap Joint.

A cross-lapped joint is when a rectangular channel is removed from both pieces of wood in the joint. The boards then interlock at right angles. The channels are cut to a depth that allows this joint to appear completely flush when joined together.



Figure 79: Butt Joint and Cross-lapped Joint
<http://www.futonlife.com/magazine/2006/spring/primer.php3>

With the doweled joint, two or more small holes are bored into two pieces of wood. Inserting small round pegs into the holes of one board then joins the boards. The

dowels are then inserted into the other board and the joint is glued. A doweled joint is also typically used in a butt joint and sometimes replaces the traditional mortise and tenon.

In a miter joint, two pieces of wood are cut at a 45° angle and the two beveled edges are placed end to end. They are usually connected with glue, nails or screws. Depending on the size of the pieces being joined, they sometimes have an additional rabbeted joint as well.

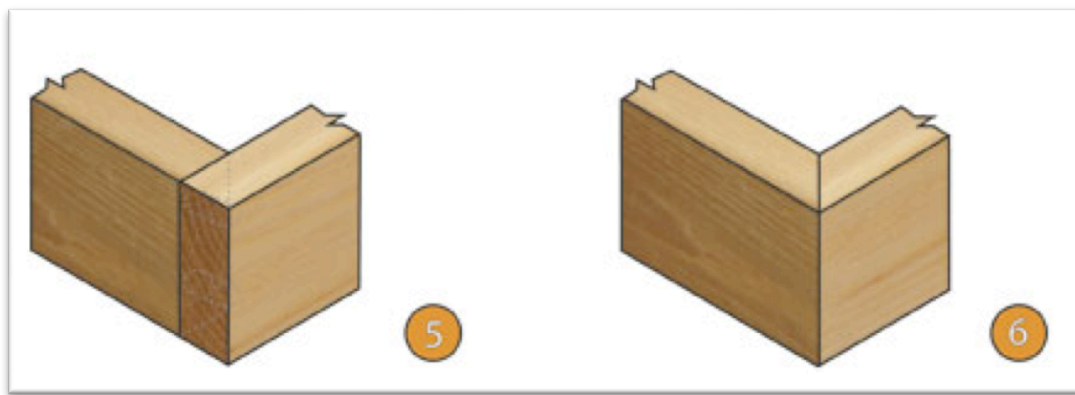


Figure 80: Doweled Joint and Miter Joint
<http://www.futonlife.com/magazine/2006/spring/primer.php3>

A dado is an adjustable blade used to create this joinery. Dado joints connect two pieces of wood by cutting a groove (with a dado blade) in one piece of wood, which is equal to the height and width of the second piece. Dado joints are often used to insert a drawer bottom. It can also be used to join the end points of two parts or to join one to the other along the length.

The dovetail joint looks similar to an outspread bird's tail. One board has a flared extension which fits into a matching flared cavity in the adjoining board. Use of a single

dovetail is called a French Dovetail, and multiple joints in the same corner are called an English Dovetail. Better drawers often use a multi-dovetail because of its strong holding power.

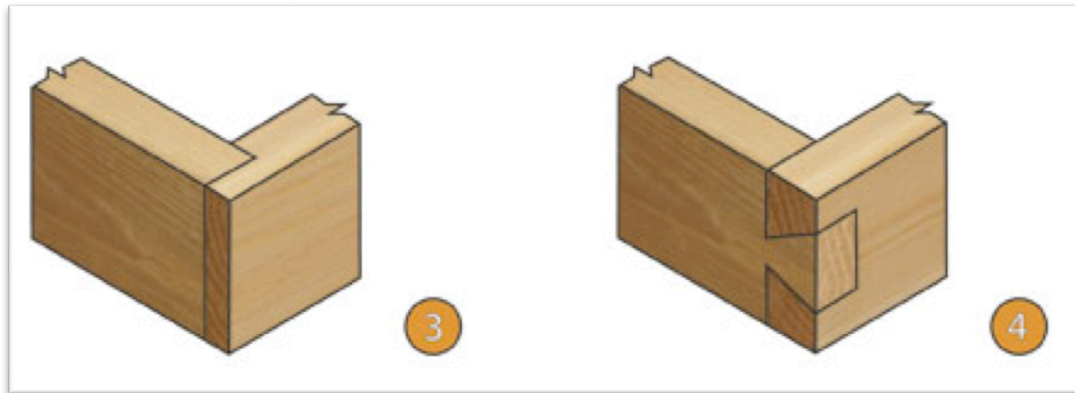


Figure 81: Dado Joint and Dovetail Joint
<http://www.futonlife.com/magazine/2006/spring/primer.php3>

In mortise and tenon, the mortised part has a recess cut into it, and the tenoned part has a protrusion that matches the recess in the mortise. The pieces are sometimes glued together to strengthen the connection and sometimes a hole is drilled through both the mortise and tenon and a dowel is inserted to further strengthen the joint.

In tongue and groove, two pieces are joined by cutting an edge or shape on one piece of wood which fits into a mirror groove cut in the other board. The tongue and groove must be cut in to fit together tightly without gaps, and the two surfaces must remain flush.



Figure 82: Mortise and Tenon Joint and Tongue and Groove Joint
<http://www.futonlife.com/magazine/2006/spring/primer.php3>

The butt joint is the most common joint for RTA furniture. It is the most simple of joints, but by simply gluing this joint, it will be very weak. The butt joint works best with reinforcement. One of the most common forms of a butts joint is nailed, however this is rarely used in furniture. With this method, the two pieces of wood are held together with several nails that may be skewed so that nails are not parallel to each other to resist the pulling apart of the joint.

Dowel reinforced butt joints are very common in furniture. The dowel-reinforced butt joints are popular in chairs, cabinets, panels and tabletops. The technique consists of cutting the members to size and then drilling a series of holes in the joint surface of each member. Holes are often drilled with the assistance of a dowelling jig, which aids in accurate hole placement. Short dowels are inserted in corresponding holes with some glue. The joint is brought together and clamped until the glue has dried. The dowels offer some holding strength even after the glue has deteriorated. Over time, dowels may shrink and become loose, creating wobbly furniture. This is why dowel joints are not preferred for high-quality furniture.

With biscuit reinforced joints, the biscuit is an oval shaped piece of specially dried and compressed wood, usually beech, which is installed in matching mortises in both members of the joint. Biscuit joints are common in both frame and carcass construction. They are particularly convenient for panel glue ups as they facilitate alignment of panel members. To create the mortise for the biscuit, a biscuit joiner is usually required. There are other methods of cutting the slot, such as a slot cutter bit in a router, but the biscuit joiner is the most common. Accuracy is not as important as in the dowel joint. When the mortises have been cut, the biscuit is inserted with some glue and the joint is brought together, aligned and clamped. The biscuit absorbs some moisture from the glue and swells up in the mortise, creating a tightly fitting joint.

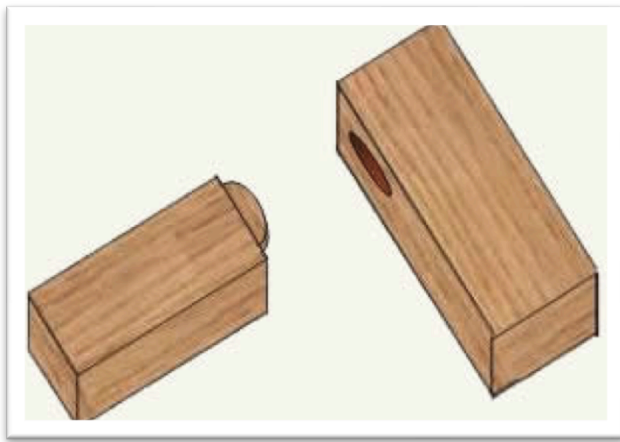


Figure 83: Biscuit Reinforced Joint

<http://www.renovation-headquarters.com/glass-cabinet-doors.html>

The screwed butt joint uses one or more screws inserted after the joint has been brought together. The screws are usually inserted into an edge on the long grain side of

one member and extend through the joint into the end grain of the adjacent member. A rule of thumb is to use a screw with a length three times the thickness of the wood.

The pocket hole screw is a variation of the screwed butt joint where the screws are inserted into pocket holes drilled in the rear face of one of the joint members. The screws extend into cross grain in the adjacent member; so much shorter screws can be used. This method is preferred when the edges of the frame will be visible. The first step is to counterbore the pocket hole itself. The second step is to drill a pilot hole concentric with the pocket hole, which extends through the edge of the member. This method may be used in RTA furniture. The furniture will already have the holes drilled, and the buyer must insert the screws.

Joinery is not only a way to join two pieces of wood, but some joinery can add to the details and craftsmanship of the furniture. Such joinery is often lost with RTA furniture, and is left to custom and high-end furniture.

Sites Used (RTA)

- <http://www.flatpack-furniture.co.uk/>
- http://en.wikipedia.org/wiki/Ready-to-assemble_furniture
- http://www.associatedcontent.com/article/369132/tips_for_shopping_for_ready_to_assemble.html?cat=6
- <http://www.wisegeek.com/what-is-flat-pack-furniture.htm>
- <http://www.allrtafurniture.com/RTA-Furniture-Terminology-The-A-Z-of-RTA-Furniture-A315.html>
- <http://www.allbusiness.com/furniture-related/office-furniture-including/322755-1.html>
- http://www.entrepreneur.com/tradejournals/article/145832716_2.html

Sites Used (Joinery)

- <http://www.futonlife.com/magazine/2006/spring/primer.php3>
- http://en.wikipedia.org/wiki/Woodworking_joints
- http://en.wikipedia.org/wiki/Dowel_joint
- <http://www.thejoinery.com/>
- http://www.horizon-custom-homes.com/Wood_Joinery.html
- http://www.do-it-yourself-help.com/carpentry_techniques.html